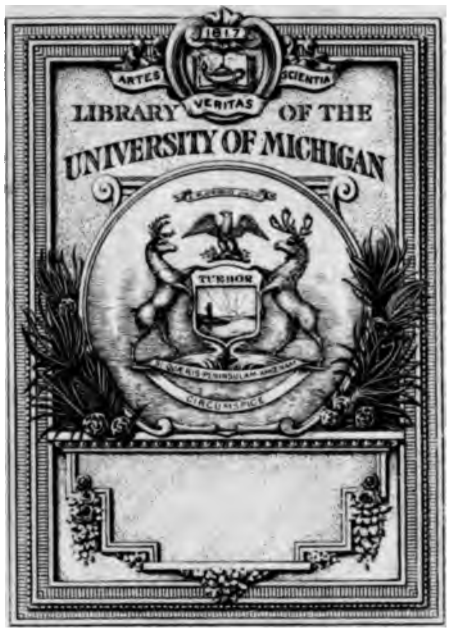

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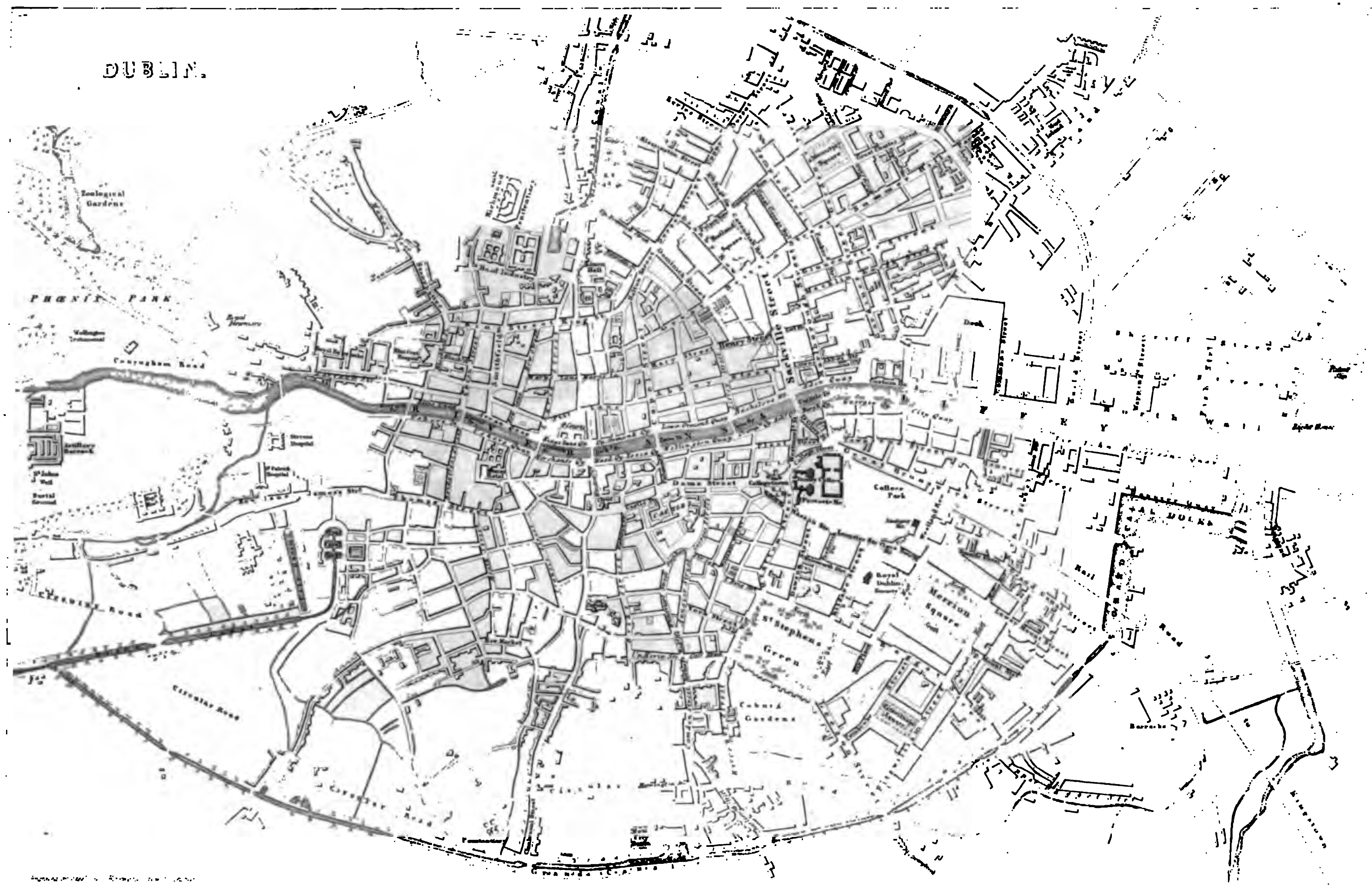


DUBLIN.
Zoological Gardens
PHŒNIX PARK
Conyngham Road
Sackville Street
Dame Street
College Park
St Stephens Green
Merrion Square
Coburg Gardens
Circular Road

PROCEEDINGS

OF

THE FIFTH MEETING

OF THE

British Association for the Advancement of Science,

HELD IN DUBLIN,

DURING THE WEEK FROM THE 10th TO THE 15th OF AUGUST, 1835, INCLUSIVE.

WITH

AN ALPHABETICAL LIST OF THE MEMBERS ENROLLED IN DUBLIN.

DUBLIN:
PRINTED BY PHILIP DIXON HARDY, 3, CECILIA-STREET.

1835.

PREFACE.

In presenting to the Public a Report of the Meetings of the British Association in Dublin, I feel it necessary at once to relieve the Gentlemen connected with the Association, as Committee, Office-bearers, &c. from any of the responsibility connected with the proceeding. I was induced to make the attempt from finding that there was no one else to do it, and from a feeling that it would be a kind of reproach to the country, were such a meeting as that of the British Association to pass over without a regular report of its proceedings. Had I been aware, at the commencement of the meetings, of the intention of the Managing Committee not to have the entire proceedings reported in an official way, I should certainly have taken measures which would have enabled me to give the very important business which came before the Sections more in detail. As it is, however, I have availed myself of every source from which I could collect materials,* and have now the pleasure of presenting the following sketch, which, as far as it goes, I presume to think, will be found correct. The difficulty and labour of giving anything like a correct report, where there were Seven separate Meetings to attend, can be only estimated by those who have been engaged in such an undertaking, and will, no doubt, be considered a sufficient excuse for any deficiency. My object in publishing the Report has been to give a still greater impulse to the excitement (of a right kind) which the presence and labours of the Association have produced throughout our country, and which would in a great measure have been lost upon our people had the Report been delayed until the publication of the volume at the end of the year. To Ireland in a very peculiar manner, does the language used by Earl Fitzwilliam, at the first meeting of the Association, apply : "in our insular and insulated country, we have few opportunities of communicating with the cultivators of science in other parts of the world. It is the more necessary, therefore, to adopt means for opening new channels of communication with them, and at the same time of promoting a greater degree of scientific intercourse among ourselves."† On this subject it has been well observed, that the Irish are an intellectual people—that intellect needs but the influence of example and the spur of glory, to arouse its activity and draw forth its vigour—these outward appliances have already been given; and we doubt not their happy results will be soon visible through all the educated classes of society. From a conviction that there are, in many districts of Ireland, individuals who would take a warm interest in the success of the British Association, were they but made aware of the purposes for which it has been established, I have deemed it judicious, by way of introduction to the proceedings of the meetings held in Dublin, to give a few extracts from the First Report, as explanatory of its objects and mode of procedure; and for so doing, I trust I shall be excused by those bearing office in the Association—my simple and only desire being to further its interests.

PHILIP DIXON HARDY.

37, *Stephen's Green, August* 28, 1835.

* For the Report of the proceedings on Monday and Tuesday in the Mathematical Section I am indebted to the pages of the *Athenæum;* the Reports of the other Sections were chiefly furnished by persons officially connected with the Association.

† Nothing could place this in a stronger point of view, than the interest evinced in the Geological Section on Monday, by English and Scotch gentlemen, in the examination of the geological maps brought forward by Mr. Griffith, in which the varied stratification of a very large proportion of this island is laid down with great precision.

ORIGIN AND OBJECTS OF THE BRITISH ASSOCIATION.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, was founded in the year 1831. Its first Meeting was held in York, in the September of that year; from an Address delivered on the occasion by the General Secretary of the Association, the Rev. WM. VERNON HARCOURT, at the time Vice-President of the Yorkshire Philosophical Society, it appears that the Association "owed its origin to some distinguished cultivators of science,* who were of opinion that great advantage might be expected from an Association for scientific intercourse in these kingdoms, formed upon the model of that which has subsisted in Germany for several years,—an Association which appears to have answered the hopes of its founders, as well in approximating men of science to each other, and promoting among them friendly feelings and an instructive interchange of ideas, as in giving to their union a collective efficacy, and bringing their aims and views more prominently into public notice."

The objects of the Association are officially stated in its Report to be—"to give a stronger impulse and a more systematic direction to scientific inquiry,—to promote the intercourse of those who cultivate Science in different parts of the British Empire, with one another, and with foreign philosophers,—to obtain a more general attention to the objects of Science, and a removal of any disadvantages of a public kind, which impede its progress. It contemplates no interference with the ground occupied by other Institutions."

"The methods now proposed are new, and therefore cannot place us in collision with any other Society. It has never yet been seen in this country, that twenty Chemists, for instance, or twenty Mineralogists, have met together, for the purpose of settling the nomenclature of their respective sciences, or attempting to fix with one consent the foundations on which they rest. It has never yet been seen, that the Chemical, Mineralogical, and Optical inquirers have assembled for the purpose of mutually explaining and learning what light the sciences of Chemistry, Mineralogy, and Optics are capable of reflecting reciprocally upon each other.

"The principles which regulate the subjects of investigation are important to be borne in mind, namely, to come to a common understanding on unsettled questions of general interest, to fix the data on which important points of theory hinge, to collect and connect extensive series of observations; these appear to be the objects which peculiarly belong to the Association, and which should therefore be chiefly, if not exclusively, contemplated."

In following out these ideas, the Rev. WM. VERNON HARCOURT, at the opening Meeting of the Association in York, observed—"The constant converse of men, who, to borrow the expression of Goldsmith, have often travelled over each other's minds, is not half so effectual in striking out great and unexpected lights, as the occasional intercourse of those who have studied nature at a distance from each other, under various circumstances and in different views; none of our existing Societies are able to concentrate the scattered forces even of its own science: they do not know, much less can they connect or employ that extensive and growing body of humble labourers who are ready, whenever they shall be called upon, to render their assistance.

"What numberless suggestions, what a crowd of valuable but abortive hints are continually floating in the thoughts of philosophers, for the pursuit of which, time is wanting to themselves! We have among us, scattered through the country, men willing to adopt these unexecuted hints, as they arise out of the profound and varied meditations of more experienced minds, men not incapable of survey-

* The Meeting was proposed by Sir David Brewster to the Yorkshire Philosophical Society in a letter to one of the Secretaries (Mr. Phillips). The proposal was approved and encouraged by the Society, and it received the most zealous and effective support from Mr. Robinson, Mr. Forbes and Mr. Johnston in Edinburgh, and from Mr. Murchison in London.

ing with accuracy a limited district, though they may not pretend to draw the general outline of the map, or fill up the whole of its details. Many such there are who only wait for instructions, and who require no other stimulus than that of being invited, to render the most essential service to researches and calculations of the highest order; and it is upon this ground especially that we venture to pronounce an Institution wanting, which shall not hesitate to make such invitations, and to offer such instructions; it is upon this ground that if we now propose to revive in the nineteenth century a plan devised two centuries ago,—we see a difference in the probability of success. Scientific knowledge has of late years been more largely infused into the education of every class of society, and the time seems to be arrived for taking advantage of the intellectual improvement of the nation. Let Philosophy at length come forth and show herself in public; let her hold her court in different parts of her dominions; and you will see her surrounded by loyal retainers, who will derive new light and zeal from her presence, and contribute to extend her power on every side. Even the experienced in science will benefit by consultation with each other; for there are different degrees of experience, and no solitary industry or talent can ever hope to equal the power of combined wisdom and concerted labour."

The nature and value of the aid which Provincial Societies might render to science through the system of the British Association, and the advantages which they may themselves derive from it, are thus stated in the Report of the Council of the Yorkshire Philosophical Society for 1831—32.

"The object of this system is not only to give connexion to the efforts of insulated inquirers, but to link Societies themselves together in unity of purpose, and in a common participation and division of labour. There are many important questions in philosophy, and some whole departments of science, the data of which are *geographically* distributed, and require to be collected by local observations extended over a whole country; and this is true not only of those facts on which single sciences are founded, but of many which are of more enlarged application. Thus, for instance, were the elevation above the sea of all the low levels, and chief heights and eminences, of a country ascertained so generally, that every observer of nature might have a station within his reach from which he could fix the relative position in this respect of whatever might be the object of his research,—of how many questions, in how many sciences, would these facts contribute to the solution? Again, supposing it to be ascertained also, at these stations, what is the temperature of the air, and of the water,—as it falls from the sky, and as it is held in the reservoirs of the earth,—these are data of the same kind, interesting not only to meteorological science, but to the philosophy of organized and animated existence. Yet, extensive as might be the importance of such facts, and simple as are the processes for ascertaining them, and numerous as are the individuals capable of contributing to their investigation, how little, nevertheless, even of this elementary work has yet been accomplished, either by insulated observers, or by those who are associated together for the express purpose of advancing the sciences to which it is of such essential interest.

"With a just sense, therefore, of the consequence to science of combining the Philosophical Societies dispersed through the provinces of the empire in a general co-operative union, the British Association has not only invited them to join its Meetings, but has given to those whom they may specially depute to represent them, the privilege of becoming members of the Committee by which its affairs are conducted.

"When individuals meet for scientific objects, the effect of the general effort, emulation, and example, is to produce a spirit of exertion which gives to such meetings their principal value. And if Societies shall concur in thus meeting each other, in proposing certain common objects, in communicating from year to year the means which they are employing and the progress which they are making, it seems impossible that this should be done in the presence of an assembly concentrating a great part of the scientific talent of the nation, without kindling an increased ardour of emulous activity; it seems impossible that the deputies of any Society should attend such meetings without bringing back into its bosom an enlargement of views, and communicating to its members new lights of knowledge, new motives for inquiry, and new encouragement to perseverance."

GENERAL RULES OF THE ASSOCIATION.

MEMBERS.

The Fellows and Members of Chartered Literary and Philosophical Societies in the British Empire publishing Transactions, shall be entitled to become Members of the Association.

The Office-Bearers and Members of the Councils, or managing Committees, of Philosophical Institutions shall be entitled, in like manner, to become Members of the Association.

All Members of a Philosophical Institution recommended by its Council or Managing Committee, shall be entitled, in like manner, to become Members of the Association.

Persons not belonging to such Institutions, shall be elected by the General Committee or Council, to become Members of the Association, subject to the approval of a General Meeting.

SUBSCRIPTIONS.

The amount of the Annual Subscription shall be One Pound, to be paid in advance upon admission; and the amount of the composition in lieu thereof, Five Pounds.

Subscriptions shall be received by the Treasurer or Secretaries.

The names of those Members of the Association whose Subscriptions shall have been in arrear for two years, and who shall not pay them on proper notice, shall be removed from the List of Members.

MEETINGS.

The Association shall meet annually, for one week, or longer. The place of each Meeting shall be appointed by the General Committee at the previous Meeting; and the arrangements for it shall be entrusted to the Officers of the Association.

GENERAL COMMITTEE.

The General Committee shall sit during the time of the Meeting, or longer, to transact the Business of the Association. It shall consist of all Members present, who have communicated any scientific Paper to a Philosophical Society, which Paper has been printed in its Transactions, or with its concurrence.

Members of Philosophical Institutions, being Members of this Association, who may be sent as Deputies to any Meeting of the Association, shall be Members of the Committee for that Meeting, the number being limited to two from each Institution.

COMMITTEES OF SCIENCE.

The General Committee shall appoint, at each Meeting, Committees, consisting severally of the Members most conversant with the several branches of Science, to advise together for the advancement thereof.

The Committees shall report what subjects of investigation they would particularly recommend to be prosecuted during the ensuing year, and brought under consideration at the next Meeting. They shall engage their own Members, or others, to undertake such investigations; and where the object admits of being assisted by the exertions of scientific bodies, they shall state the particulars in which it might be desirable for the General Committee to solicit the co-operation of such bodies.

The Committees shall procure Reports on the state and progress of particular Sciences, to be drawn up from time to time by competent persons, for the information of the Annual Meetings.

LOCAL COMMITTEES.

Local Committees shall be appointed, where necessary, by the General Committee, or by the Officers of the Association, to assist in promoting its objects.

Committees shall have the power of adding to their numbers those Members of the Association whose assistance they may desire.

OFFICERS.

A President, two Vice-Presidents, two or more Secretaries, and a Treasurer, shall be annually appointed by the General Committee.

COUNCIL.

In the intervals of the Meetings the affairs of the Association shall be managed by a Council, appointed by the General Committee.

PAPERS AND COMMUNICATIONS.

The General Committee shall appoint at each Meeting a Sub-Committee, to examine the papers which have been read, and the register of communications; to report what ought to be published, and to recommend the manner of publication. The Author of any paper or communication shall be at liberty to reserve his right of property therein.

ACCOUNTS.

The Accounts of the Association shall be audited annually, by Auditors appointed by the Meeting.

TRUSTEES OF THE BRITISH ASSOCIATION.

Charles Babbage, F. R. S. Lucasian Professor of Mathematics, Cambridge.
R. I. Murchison, F. R. S. Vice-President of the Geological and Royal Geographical Societies.
John Taylor, F. R. S. Treasurer of the Geological Society, &c.

OFFICERS OF THE ASSOCIATION, FOR THE YEAR 1835.

President—Rev. Bartholomew Lloyd, D. D. Provost of Trinity College, Dublin.
Vice-Presidents—Lord Oxmantown, F. A. S. &c. Rev. William Whewell, F. T. C. C., F. R. S. &c.
Treasurer—Tohn Taylor, F. R. S. Treas. G. S. &c.
General Secretary—Rev. William Vernon Harcourt, F. R. S. G. S. &c.
Assistant Secretary—John Phillips, F. G. S. &c. Secretary to the Yorkshire Philosophical Society.
Secretaries for Ireland—Sir William Rowan Hamilton, F. R. S. Royal Astronomer of Ireland, &c. &c.
Rev. H. Lloyd, F. T. C. D. &c. Professor of Natural Philosophy in the University of Dublin.
Treasurer for Ireland—Thomas Herbert Orpen, M. D. South Frederick-street.

COUNCIL.

G. B. Airy, F.G.S., Rev. William Buckland, D.D. F.R.S. &c., Robert Brown, D.C.L. F.R.S. &c. C. Bentham, William Clift, F.R.S. &c., S. H. Christie, F.R.S., J. E. Drinkwater, C. B. Greenough, F.R.S. &c., T. Hodgkin, M.D., J. W. Lubbock, F.R.S., G. Rennie, F.R.S., Rev. G. Peacock, F.R.S. P. M. Roget, M.D. Sec. R.S., William Yarrell.

Ex-Officio—The Trustees and Officers of the Association.

Secretaries—E. Turner, M.D. F.R.S. &c., Rev. J. Yates, F.G.S.

THE LOCAL COUNCIL

Consisted of the Officers of the Association residing in Dublin, and of the following additional Members, named 4th December, 1834:

James Apjohn, M. D., M. R. I. A.; Francis Barker, M. D., M. R. I. A.; Richard Griffith, *Pres.* G.S. M.R.I.A.; John Hart, M.D., M.R.I.A.; Robert Hutton, F.G.S., M.R.I.A.; Samuel Litton, M.D., M.R.I.A.; Mountifort Longfield, LL.D.; Captain Portlock, R.E., M.R.I.A.; Rev. George S. Smith, F.T.C.D., M.R.I.A.; Isaac Weld, *Sec.* R.D.S., M.R.I.A.

RECEPTION COMMITTEE, APPOINTED 25th APRIL, 1835.

Richard Cane; A. Carmichael M.R.I.A.; George Carr; J. Sisson Cooper, M.R.I.A.; Hon. Thomas Barnwall, M.R.I.A.; Loftus Bland; Robert Borrowes; E. Borough, M.R.I.A.; Charles Brown, Jun.; J. W. Cusack, M.D., M.R.I.A.; Robert Graves, M.D., M.R.I.A.; Charles W. Hamilton; J. R. Corballis, M.R.I.A.; W. Edington; J. Pim, Jun. M.R.I.A.; Cornelius Sullivan; Captain Hooke; Arthur Hume, M.R.I.A.; Henry Kemmis; Hon. Edward Lawless; B. C. Lloyd; Sir Charles Morgan; Hon. Sir Francis Stanhope; W. Stokes, M.D.,M.R.I.A.

Secretary—R. Evanson, M.D., M.R.I.A.

OFFICERS OF SECTIONS.

SECTION A.—MATHEMATICS AND PHYSICS.

President—Rev. Dr. Robinson.
Vice-Presidents—Sir Thomas Brisbane, Mr. Baily.
Secretaries—Professor Hamilton, Professor Wheatstone.

SECTION B.—CHEMISTRY AND MINERALOGY.

President—Dr. T. Thomson.
Vice-Presidents—Dr. Dalton, Dr. Barker.
Secretaries—Dr. Apjohn, Professor Johnston.

SECTION C.—GEOLOGY AND GEOGRAPHY.

President—Mr. Griffith.
Vice-Presidents—Mr. Murchison, Professor Sedgwick.
Secretaries—Captain Portlock, Mr. Torrie.

SECTION D.—ZOOLOGY AND BOTANY.

President—Dr. Allman.
Vice-Presidents—Dr. Daubeny, Professor Graham.
Secretaries—Mr. Curtis, Dr. Litton.

SECTION E.—ANATOMY AND MEDICINE.

President—Dr. Prichard.
Vice-Presidents—Dr. Colles, Dr. Crampton, Surgeon-General.
Secretaries—Dr. Harrison, Dr. Hart.

SECTION F.—STATISTICS.

President—Mr. Babbage.
Vice-Presidents—Colonel Sykes, Rev. E. Stanley.
Secretaries—Professor Longfield, Mr. Greg.

SUB-SECTION A.

President—Mr. G. Rennie.
Vice-President—Dr. Lardner.

ARRIVAL OF THE MEMBERS—PRELIMINARY ARRANGEMENTS FOR THE MEETINGS.

The First General Meeting of the British Association having been held at York, in 1831—the second, in Oxford—the third, in Cambridge—and the fourth, in Edinburgh—it was at the last mentioned meeting resolved, in compliance with pressing invitations, received from the Board of Trinity College, the Royal Irish Academy, and the Royal Dublin Society, that the Fifth General Meeting of the Association should take place in Dublin, 10th August, 1835. In consequence of this announcement, a Local Council of Management was appointed; and it is scarcely necessary to say, that the trust committed to them was performed in a manner calculated not only to insure the comfort and accommodation of the numerous distinguished individuals who visited our shores on the occasion, but in a very especial manner to promote the great objects for which the Association was formed—the intercourse of scientific men—the diffusion of light and knowledge—to elicit truth, as connected with science, and to extend its boundaries.

In the anticipation of the city being visited, as it has been, by some of the most celebrated geologists in the British empire, the Dublin Society directed their Professor, Doctor Scouler, to prepare a description of the objects of Geological interest in the neighbourhood of Dublin, and a Map to illustrate it, which was accordingly done, and distributed amongst the Members at the Geological Section.*

Early in the week preceding that on which the meetings of the Association were held, the city began to be crowded with members from various places; and here it is only just to place on record, the kindness and liberality of Sir John Tobin, who, from a wish to forward the objects of the Association, with a munificence beyond all ordinary praise, not only gave a free passage in his steam vessel, the William Penn, to all members of the Association coming *via* Liverpool, but, for their greater accommodation, made trips, on two several days; crossing over himself each time, that he might by his presence add to the happiness of his guests, in the exercise of the most unbounded hospitality, his vessel being well stored with the choicest wine and provisions which the country or the season could afford.

On their arrival at Kingstown, the distinguished strangers were met by members of a Committee of Reception, which had been previously formed; and a special train of carriages belonging to the Railway Company, having awaited their arrival, they were at once conveyed to town, and conducted to the various places in which they were to reside during their stay.

Accommodations were provided for a great number of the guests within the walls of the College, and arrangements made for their breakfasting and dining together in the College Hall, by which the intercourse between the members was greatly facilitated.

The hospitalities of private life were also liberally exercised; and indeed so perfect were the arrangements, that we believe not a single individual had to complain of want of attention or neglect. As, however, it would have been impossible to provide free accommodations for all, arrangements were made at Morrisson's, the first hotel in the city, by which those members of the Association who wished to dine together, might do so at a reduced rate, the surplus having been paid out of a local fund, raised for the purpose of bearing this and all other incidental expenses. There was also a dinner provided at Marsh's, Salt-hill, on Thursday, the 13th, where nearly three hundred members dined.

Plans of the Tables were shown in the Hall of Trinity College, so as to enable Members to select their places, and no gentlemen, except members of the Association, were admitted to any of the ordinaries.

* We have the satisfaction of presenting to our readers the Map alluded to, obtained by special permission, which was prepared, as we have stated, under the sanction of the Royal Dublin Society, and accurately engraved by Mr. John Kirkwood.

The Examination Hall, Trinity College, was appointed as the place of general rendezvouz; and on the mornings of Friday and Saturday preceding the week of the regular meetings, it presented a most interesting and animated scene. It was literally crowded with scientific and learned men, among whom were many of the most eminent characters of the present day—Professors from Cambridge, Oxford, and Edinburgh—some from the Continent, and a numerous assemblage of the literati of our own land. As it might appear invidious to name any, where there were so many gifted individuals, we would at once refer to the list appended to our Report, for the names of those distinguished persons who were present during the meetings.

On Saturday, the 8th inst. a meeting of the General Committee was convened in the Library of the Royal Irish Academy, at which the arrangements for the subsequent meetings, and the appointments of officers for the Sections, were submitted, and finally agreed upon. The Committee of Reports and Recommendations also met every day during the week, to receive the suggestions of the Committees of the Sections on subjects connected with the advancement of science, and to recommend to the General Committee such measures as seemed most conducive to that end. A printed list of the Names of Members that arrived, with their Addresses in Dublin, were delivered on the mornings of Monday, Tuesday, Wednesday, and Friday.

During the preceding week so many candidates had presented themselves, that the Local Council was compelled to limit the recommendations for admission, and after Wednesday, 5th of August, to refuse, unless under special circumstances, all applications made by persons residing in Dublin, such gentlemen having had the most ample time and opportunity of offering themselves for election, and having been repeatedly invited to do so from the commencement of the year; a great number were in consequence disappointed, but the measure was absolutely necessary, as accommodation could not be afforded to all.

The General Meetings of the Association were held in the rooms of the Rotunda, on Monday, Wednesday, and Friday, in the evening; and there was a concluding meeting on Saturday, before dinner. The Members assembled in the same rooms on the evenings of Tuesday, Thursday, and Saturday; and the Rotunda Gardens were lighted up as a promenade on these latter evenings. The chair was not taken, although several interesting matters were brought forward. A limited number of Ladies' Tickets were issued for the General and Evening Meetings in the Rotunda—in the supper rooms of which, ices, fruits, tea, coffee, &c. &c. were supplied in the utmost profusion, the expense being met by the Local Subscription Fund. On these occasions nearly 2000 persons assembled every evening during the week.

The following public Institutions of Dublin were opened to Members, on the exhibition of their Tickets:—The Library and Museum of Trinity College; the Botanic Garden of Trinity College, Ball's Bridge; the Library and Museum of the Royal Dublin Society; the Botanic Garden of the Royal Dublin Society, Glassnevin; the Library and Museum of the Royal College of Surgeons, St. Stephen's Green; the Dublin Library and Reading Room, D'Olier-street; the Reading Rooms of the Chamber of Commerce; the Zoological Gardens, Phœnix Park; and the Ordnance Survey Office, Phœnix Park.

On the whole, the arrangements were excellent—indeed great praise is due to the Local Council and Reception Committee, for the regularity and order with which, by previous good arrangement, the machinery of the Association was made to work during the entire week.

On Saturday, the 8th instant, several of the eminent men who had come over to attend the meeting dined with the President of the Association, and in the evening of that day the Royal College of Physicians invited most of the members that had arrived to a *conversazione* in their library and museum, at Sir Patrick Dun's Hospital. The chair was taken by Dr. Jonathan Osborne, who read a preliminary paper, in which he noticed the monthly *reunions* of the members of the College, held

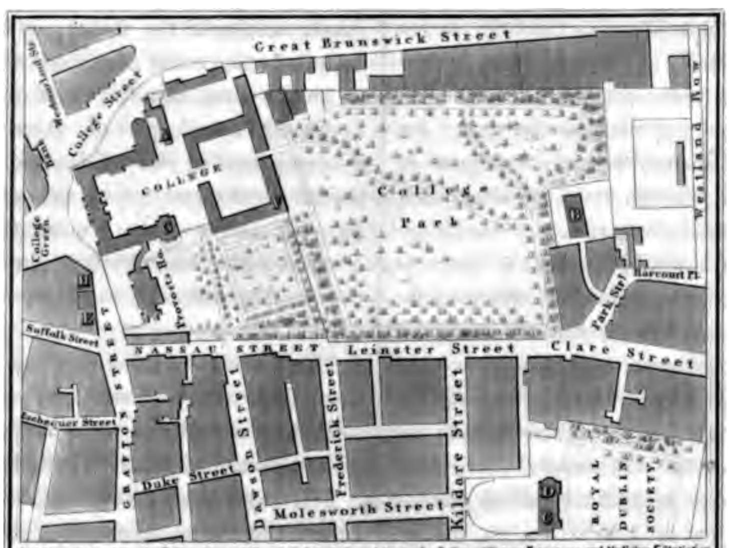
regularly in the Hospital, and alluded to the most interesting papers and cases which had been brought before them. When Doctor Osborne's address was concluded, papers were read by Drs. Marsh and Montgomery, after which the company adjourned to supper in the state apartments.

On Monday morning the scene that presented itself in the Examination Hall, which was crowded to excess, was, if possible, still more animating than that which had been witnessed on the previous days. At eleven o'clock, according to the arrangements agreed upon, the different Sections proceeded to the places in which their meetings were to be held during the week, as follows :

A. *Mathematics and Physics*, in the Philosophy School, Trinity College.
B. *Chemistry and Mineralogy*, Chemical School, ditto.
C. *Geology and Geography*, Theatre of the Royal Dublin Society.
D. *Zoology and Botany*, Board-room, ditto.
E. *Anatomy and Medicine*, Council-room, Royal Irish Academy.
F. *Statistics*, Divinity School, Trinity College.

A Sub-Section, subsequently formed, for Mechanical Science applied to the Arts, was held in the Law School of the University under the Library.

For the convenience of strangers, a section of the city in which the Meetings took place, was printed on the back of the Tickets of Admission. We insert this, as well as some other minute particulars, to serve as a guide to those who may have the conducting of future meetings of the Association.



A. Mathematics and Physics. B. Chemistry and Mineralogy. C. Geology and Geography. D. Natural History. E. Anatomy and Medicine. F. Statistics. G. General Rendezvous. H. General Committee.

MEETINGS OF THE ASSOCIATION ON MONDAY, AUGUST 10.

SECTION A.—MATHEMATICS AND PHYSICS.

DR. ROMNEY ROBINSON IN THE CHAIR.

At the hour appointed for the commencement of business, the room was crowded to excess, and numbers were unable to obtain admission. The proceedings of the day were commenced by

The Rev. W. WHEWELL, who read the first part of a report upon the 'Mathematical and Dynamical Theories of Electricity, Magnetism, and Heat.' In the opening of it he gave a slight sketch of the history, explained briefly Franklin's Theory, and described the reduction of this theory to mathematical language by Æpinus. Although this theory at first sight appeared simpler than the theory of two fluids, soon after maintained by Coulomb and Poisson, yet when reduced to the precision of a mathematical science, it was, in truth, found to be more complicated; since, to explain certain phenomena, particularly the repulsion of two negatively electrified bodies, in conformity with the theory of Franklin, it was necessary to add a second hypothesis—viz. that "the particles of bodies themselves, when stripped of any portion of the electric fluid, repelled each other;" an hypothesis which seems to be inconsistent with the well-established fact of the universal gravitation of all particles of material substances. The author then detailed the results of the experimental researches of Coulomb, and showed the beautiful accordance of them with the mathematical investigations of Poisson, particularly dwelling upon—first, the law of attractive and repulsive influence at a distance, which proved to be the same as that of gravitation, viz. the inverse square of the distance; and, secondly, the distribution of electricity upon the surfaces of electrified bodies of various shapes. He then detailed, and highly eulogized, some late experiments by Mr. Snow Harris, of Plymouth, and concluded the electrical portion of his report, with an examination of the accordances and disagreements of the results of these celebrated men.

The author then proceeded to the magnetical portion of his report. First, he touched slightly on the experimental researches of Gilbert and the earlier philosophers; detailed the advancement of the science to mathematical dignity in the hands of Æpinus; and then dwelt upon the exact experimental results of Coulomb's investigations, and the law of the force and distribution along a needle, from one pole to the other. The author finally alluded to the remarkable results of the experiments of Mr. Barlow as to the law of the action of masses of iron on the magnet, and observed that these results were confirmed by the mathematical speculations of Poisson, who showed that the laws discovered by Barlow were correct and simple results of the theory, and that the magnetic influence could alone, as, in fact, was found to be the case, manifest itself upon the surface. From the knowledge of these laws resulted the compensating plate of Barlow for neutralizing the effects of ships' iron on the compass, and thus securing mariners from a most dangerous source of error. Mr. Whewell then stated that he would reserve the portion of his report upon the theory of heat to a another day.

The President having expressed a wish to hear the sentiments or remarks of any member of the section, who should now wish either to confirm or dissent from any of Mr. Whewell's views,

Mr. SNOW HARRIS rose and stated, that he conceived the mode of experimenting adopted by Coulomb was subject to a source of error not hitherto noticed—namely, that the proof plane of Coulomb became itself electrified by induction as it approached the body, whose electricity was

to be examined; and that the shape of the body at the several points to which the proof plane was made tangent, most materially affected the quantity and tension of the electricity developed upon it; in consequence of which, he conceived that the laws of distribution deduced from the experiments of Coulomb were not to be depended upon.

Mr. WHEWELL conceived, that as the tangent or proof plane was very small, and the same proof plane applied successively to the several parts of the surface, the comparative results must be correct.

Mr. HARRIS dissented, stating that he would soon have an opportunity of bringing his view more in detail before the section.

Professor STEVELLY requested to know from Mr. Whewell, whether he conceived Coulomb to be the first person who promulgated the theory of two fluids in electricity. Professor Stevelly stated that he held in his hand a book, printed in 1771, 'Philosophical Essays,' by Henry Eels, Esq. of Waterford, in which he publishes letters sent by him to the Royal Society of London, and complains that Dr. Priestly had not given them earlier publicity. In a letter, under the date of 12th April, 1756, he clearly gives the theory of two electrical powers or fluids, experimentally establishes their existence and diversity of properties, points out truly the modification required in the law of attraction and repulsion, as given by Franklin, in order to harmonize his law with the experimental facts produced by himself, and gives some excellent views of magnetical phenomena. Professor Stevelly also stated, that in a previous letter, dated 18th June, 1752, he had given very strong reasons for concluding, that the cause of thunder and lightning was identical with electricity, and had even produced an electrical theory of the suspension of vapour and the fall of rain.

Professor WHEWELL explained, that his statement only had reference to the theories as mathematically developed.

Mr. SNOW HARRIS then read an interesting paper upon a New Balance, for the measurement of minute electrical forces, an instrument much better adapted to experimental researches in electricity than the torsion balance of Cavendish and Coulomb. The defects of the torsion balance, as he found, were :—1. That the received law of torsion, though perhaps true in hypothetical cases, could not be depended on in practice. 2. Where this law was most to be depended upon, the angle of torsion for the smallest forces was so large as to require adjustments of the instrument difficult to be obtained, and scarcely susceptible of accuracy. 3. The instrument was very unsteady, and required much time in operation. His instrument consisted essentially of a needle, reed, cylinder, or bar, suspended by two distant parallel and vertical fibres of silk. When this bar is turned round the centre, the suspending threads being brought into an oblique position, its centre of gravity is compelled to rise; the weight of the bar, therefore, tends to bring it back to its previous position, with a force directly proportioned to the angle of torsion in a given instrument, and bearing a very easily determined relation to the weight of the bar, the length of the suspending fibres, and their perpendicular distance. He then exhibited models illustrative of the principles and formulæ which he had detailed, and showed and explained the neat and ingenious adjustments of a highly-finished instrument of this description, exhibiting some interesting electrical experiments, showing its use, and illustrative of its extreme sensibility. The exhibition and description of this instrument, called forth the strongest expression of applause from the Section.

Professor POWELL read a paper on the Radiation of Heat. He commenced by giving a succinct account of the late researches of Melloni and of Forbes. He had not succeeded in establishing the polarization of heat from non-luminous bodies; but Forbes, by the use of the thermo-multiplier, had triumphantly established the fact. Melloni had tried his experiments on heat, derived from the sources of—1. a lamp;—2. incandescent platina;—3. brass heated by a lamp;—4. copper so heated as not to be luminous. He established the fact, that the *ratio* of the heat transmitted through screens is *different* for luminous and for non-luminous bodies; and he hence concludes, that the material of heat exists in two essentially distinct states, or that there are two kinds of heat—1. that heat whose type we have from the sun, and other self-luminous bodies;—2. the heat whose type we have from boiling water and other non-luminous bodies.

Doctor HUDSON next read a paper on the radiation of heat, and described a differential thermometer, much more sensible than Leslie's, made with sulphuric ether, coloured with dragon's blood.

The chief peculiarity of his experiments, consisted in his heating the mirror for reflection; he tried the diathermacy of rock salt, and confirmed a conclusion of the previous paper. He asserted, that his experiments on the radiation of cold could not be accounted for on any theory but the undulatory; and ended by stating, that the zeal caused by the approach of the British Association, was the mainspring of his exertions in this field.

Sir JOHN ROSS then read a paper on the origin of the Aurora Borealis; the result of twenty-five year's reflection on the subject. Having frequently noticed that the Aurora was visible *between* two not very distant ships, and likewise between the ship and an iceberg, he concluded that Wollaston's opinion, that this meteor took place at great altitudes, must be erroneous. His own opinion was, that it was caused by the sun's rays striking on the circumpolar fields of ice and glaçiers, and then reflected from very thin clouds aloft in the atmosphere.

Mr. ROBERTS read a paper on Optical Phenomena; and Mr. RUSSELL one on Floating Bodies.

Mr. ROBERT MALLET next described an electro-magnetic machine for the purpose of separating iron filings or turnings from brass or other finely divided metals. The arrangement consists of several electro-magnets placed vertically over each other, and all excited by a single pair of large plates. A chain of buckets discharges the mixed metallic particles over the magnets, the iron adheres to them, and the brass, &c. drop into a dish beneath. The latter is removed, and at the same instant, the communication between the poles of the battery is broken; when the greatest part of the iron drops into the space between the dish containing the brass and that provided for the next portion. The mechanical motions are performed by steam power or any other first mover.

SECTION B.—CHEMISTRY AND MINERALOGY.

DR. THOMPSON IN THE CHAIR.

Professor DAVY read a very interesting and important paper on the protection of metals attached to buoys, in which he mentioned some very curious facts with regard to the corrosion of iron by sea water, and illustrated his statements by a variety of experiments. The mode in which he proposes to secure iron, is by means of portions of zinc attached to it, in consequence of which the electrical state of the iron is altered.

Dr. KANE suggested that, as the iron in Professor Davy's experiments is protected at the expense of the zinc, it would be important to determine the actual quantity of zinc lost, for a certain amount of iron saved. The corrosive action being merely diverted from one metal to the other, the economy of the protection might be very seriously influenced by that circumstance, the value of zinc being so much greater than that of iron.

After this paper was read, a discussion took place, in which Mr. Harcourt, Professor Johnston, Drs. Traill and Read joined, relative to the action of salt water, when heated, on the boilers of steam-engines, and its comparative action on wrought and cast iron; but no satisfactory conclusion was arrived at, and this part of the subject remains for future investigation.

Mr. ETTRICKE next explained a new Safety Lamp, but it appeared to give little satisfaction, owing to the danger arising from the fragile nature of the materials, and the liability of the glass to be broken by slight changes of temperature. Dr. Daubeny and Mr. Johnston each explained some new improvements in this most important instrument.

Professor KANE stated that he had been led to examine the properties of pyroxylic spirit, in order to discover whether Liebig's idea of its nature was correct. He (Dr. Kane) had found, that when treated with sulphuric acid, and the mixture neutralized by a base, salts are generated, forming a new and peculiar class, of which he had exhibited specimens at the Royal Irish Academy prior to his becoming aware of Dumas' and Peligot's valuable researches on pyroxylic spirit, and the bodies derived from it.

In order to render the account of his researches simpler, Dr. Kane stated the results to which the French chemists had arrived, and which appear to be confirmed by his experiments. Dumas considers pyroxylic spirit to consist of 2 atoms of carbon, 4 of hydrogen, and 2 of oxygen. Its atomic weight being = 32. When treated by sulphuric acid various products are formed. Thus, by the subtraction of an atom of water, there is formed a gaseous body consisting of 2 atoms of carbon, 3 of hydrogen, and 1 of oxygen—a body composed precisely like alcohol, and having an atomic

weight of 23. This body acts as a base uniting with acids, and forming salts like the ethers.

To account for these reactions, Dumas assumes the existence of a base consisting of 2 atoms of carbon, and 2 of hydrogen, to which he gives the name Methylene. Then there are

$(2\,C+2\,H)+\dot{H}=$ proto-hydrate of Methylene or Methylene Ether.

$(2\,C+2\,H)+2\,\dot{H}=$ bi-hydrate of Methylene or Pyroxylic Spirit.

The methylene ether unites with 2 atoms of sulphuric acid, forming the sulpho-methylic acid, of which one salt only had been examined by Dumas. Dr. Kane's researches had been principally directed to developing the history of its combinations, the nature of which may be briefly explained.

The sulpho-methylate of potash crystallizes in pearly plates, is very soluble, decomposed by heat, giving a heavy oil, (sulphate of methylene) and sulphate of potash, decomposed by a base giving pyroxylic spirit. Its composition is,

$$(2\,\dddot{S}+\overline{(2\,C+2\,H)+\dot{H}+\dot{K}})+\dot{H}$$

The sulpho-methylate of baryta crystallizes also in plates; its formula is

$$(2\,\dddot{S}+\overline{(2\,C+2\,H)+\dot{H}+\dot{B}a})+2\,\dot{H}$$

The sulpho-methylate of lime crystallizes in octoëdrons, and is anhydrous.

The salt of lead, usually obtained, crystallizes in beautiful long rectangular prisms; it contains one atom of water. Another form is in plates, resembling the salt of baryta, and contains more water, but is so unstable in its arrangements that Dr. Kane could not complete its examination.

The salts of soda, ammonia, zinc, magnesia, copper, nickel, and alumina, were also described, but did not present anything very remarkable.

When Dr. Kane's paper had been read, Dr. Dalton mentioned that he had long since analysed pyroxylic spirit, and showed that it was composed of an atom of olefiant gas, united to an atom of water. The learned doctor appeared to consider this result different from that of Dumas, as quoted by Professor Kane, and adverted to the very prevailing tendency, among the young chemists of the present day, to follow the views of foreigners rather than of their fellow-countrymen, who were engaged in the same field.

Dr. Kane explained to the Section, that the results of Dr. Dalton agreed precisely with those of Dumas, as might be expected, both chemists being of so high and so well-deserved celebrity. Dr. Dalton, of whose labours Dr. Kane regretted he had not been previously aware, made pyroxylic spirit to consist of 1 of carbon, 2 of hydrogen, and 1 of oxygen, and its atomic weight 16. Dumas gave it precisely the same composition, but doubled the atomic weight; and that the atomic weight is really 32 and not 16 is completely proved by the analysis of the salts of sulpho-methylic acid, that had been just read to the Section.

Mr. Fox made a statement relative to the effects of iron, when strongly heated, on the magnet: he mentioned, that when iron was let run in a state of fusion into a trough, near which was placed a magnetized needle, that no effect was observed on the needle, until the iron has cooled to a low red heat, and that then the needle was strongly attracted. This observation, he observed, was of great importance to the geological views relative to central heat.

A letter was read from Dr. Turner, apologizing for his absence from the meeting, owing to ill health, and detailing the progress he had made, in reference to the recommendation of the Association last year, respecting the introduction of a uniform system of Chemical Notation among British chemists.

SECTION C.—GEOLOGY AND GEOGRAPHY.

Mr. Griffith presented his Geological Map of Ireland, the result of many years' research and labour, assisted in part by the publications of Weaver, Conybeare, Buckland, and Berger. Mr. Griffith, in pointing out the inaccuracies of existing maps of Ireland, dwelt on the advantages which will attend the publication of the Ordnance Maps, four counties of which had now appeared. At present, great difficulties attend the allocation of geological phenomena, which are frequently misplaced in relation to each other, from the necessity of following the defects of the old maps. Mr. Griffith, as an example, stated that in Arrowsmith's map, Benwee Head is placed twenty miles north of the parallel of Sligo, though it is actually due west of that town. The remarkable position of the mountain masses was first pointed out. They occur on the margin of the island, and enclose the great central limestone plain—an arrangement which shortens the courses of the rivers, rising as

they do in the higher grounds, and rapidly descending to the sea. The Shannon is an exception, having a course of 140 miles; but it also is affected by the peculiarity alluded to, its stream falling eighty feet in the first twenty miles of its course, and only eighty feet more in the remaining 120. On the great plain, which occupies the centre of the island, numerous beds of gravel occur, called Escars, which though constant in direction, when considered in reference to small spaces, are variable when the comparison extends over greater limits. Mr. Griffith considers the great bogs as due to these accumulations of gravel, which, by damming in the water, facilitate the growth of sphagnum palustre. Under the bogs are deep deposits of marl, underlaid by clay and gravel, which further support the idea of ancient lakes. The marl was stated to be in one instance forty feet thick. Mr. Griffith, confining himself on this occasion to the sedimentary rocks, commenced his illustrations by those of a more crystalline character, such as gneiss, mica slate, &c.; and stated that he considered the great groups of Ireland as corresponding to those of Scotland; particularly the Northern to the Grampians, and the Mourne to the Dumfriesshire Mountains. The general direction of stratification is N.E. and S.W., though in Tyrone it is more nearly N. and S., being referred to a local axis; and in the south nearly E. and W. The beds of primary limestone, associated with the primary schists, are not continuous, though they occur in lines: when intersected by trap dykes, they become dolomitic. The quartz rock which is also associated with these schists, is sometimes very remarkable. At Dunmore Head it has the structure of orbicular granite, or of some varieties of trap, for which it is often mistaken. Mica slate is unequally distributed: it is abundant in the north and west, less general in the south, and deficient in the Mourne or Down district. Mica also, as a mineral, is not general, being in the Mourne Mountains often replaced by hornblende. Proceeding to the transition schists, Mr. Griffith stated his conviction that they would require subdivision whenever materials had been collected for the purpose, in the same manner as those of Wales had been divided by Mr. Murchison. For example—in the older schists, neither conglomerates nor organic remains are found. In the newer greywackes, the slates alternate with sandstone; and again, in the still newer strata, limestone containing fossils alternates with the upper portion of the schists. The old red sandstone is also considered by Mr. Griffith divisible into two or three sub-sections—the upper alternating with the mountain limestone. Mr. Griffith then described the several coal fields of Ireland, pointing out the distinction between those of the north and south—bituminous coal being confined to the northern collieries. The more recent sedimentary rocks were then briefly described; more especially the new red sandstone which underlies the lias and chalk on the S. and E. of Antrim, and is also found in Monaghan, and may be traced thence through Tyrone and Derry to Lough Foyle, and round Lough Foyle to Donegal.

Messrs. Greenough and Murchison, and Professor Sedgwick expressed their satisfaction at the appearance of Mr. Griffith's map, and at the lucid manner in which it had been illustrated. The colours adopted were those used by Mr. Greenough in the Geological Map of England.

Mr. James Bryce, in reference to Mr. Griffith's notice of the new red sandstone, pointed out its similarity in the N.E. of Down to corresponding beds on the other side of the channel, as described by Mr. Murchison, this identity being particularly supported by the occurrence and position of the magnesian limestone of Cultra. Mr. Bryce then adduced examples of transported materials occurring in the gravel beds, which could not have been supplied by the rocks of the vicinity. In Antrim, for instance, he supposes the fragments of primary rocks to have come from Donegal: and in Down, the fragments of chalk, flints, and trap to have come from Antrim—thus, in his opinion, establishing a general north or north-western current.

Captain Portlock observed, that a very rigid comparison of the removed fragments, and of the parent rocks, was essentially necessary before any conclusion could be drawn from the pebbles of primary rocks found in the gravel beds, since such rocks, in endless variety, were to be found in so many different localities—as well, for example, in Antrim, as in Derry or Donegal: nor was it possible yet to say that all such localities were known, as within the last few months he had announced to the Geological Society of Dublin the discovery of a small granitic district in Cavan, unknown even to Mr. Griffith. From pebbles of chalk and trap more correct deductions might be drawn; but in the case of Down, the distance they have travelled is small; and though the transport is a good and strong proof of a

local current in that direction, it is not sufficient to establish a general one over the whole country. Captain P. considered that it is far more probable that the modifications of the earth's surface into valleys—or in other words, the elevations of distinct groups of mountains as well as of the lower strata, have in like manner modified the directions of currents from that general direction, which may be expected to follow the motion of the earth and other physical phenomena. But it is to the great central plain of Ireland that attention should be turned, as it affords an ample scope for the operation of the great moving currents. At present the gravel resting upon it is supposed to be limestone, that is local, and arranged in a variable manner, as before stated. Captain Portlock considers also that the regular arrangement of gravel in beds separated by sand, distinguishes it as a phenomenon from those scattered masses or boulders which often rest on the very summit of the gravel ridges.

Professor SEDGWICK pointed out, in confirmation of Mr. Griffith's views, many striking instances of agreement between the strata of Ireland and those of Scotland.

Mr. MURCHISON declared that during the *exposé* of Mr. Griffith, he had filled several pages of his memorandum-book with information which was entirely new to him: and he congratulated the meeting on the appearance of the excellent maps of the President. He also thanked the Geologists of Ireland for having prepared a small work, elucidating the geological structure of the environs of Dublin (by Dr. Scouler), and said that he had already found it to be of the greatest service in examining the northern base of the Wicklow mountains.

As this Section combines geography with geology, Dr. WEST read a very curious paper on the errors committed by geographers, in considering Cape Farewell and Statenhook as two distinct places—the latter having been called an inlet, in spite of the clear etymological meaning of the name. Dr. West traced this error to its source, and having clearly established the identity of the supposed two places, he further entered into an enquiry as to the existence or non-existence of the doubtful colony on the east coast of Greenland. This question, by the aid of Lieutenant Graah's testimony, a Danish navigator, he satisfactorily decided in the negative, coming to the conclusion that no colonization was ever effected on the east coast of Greenland.

Mr. MURCHISON said, that as Vice-President of the Geographical Society, he hailed with pleasure the exhibition of critical acumen and learned research which had been displayed by Dr. West in this elaborate and interesting paper.

SECTION D—ZOOLOGY AND BOTANY.

DR. ALLMAN IN THE CHAIR.

Mr. NIVEN submitted a paper on the Formation of a Natural Arrangement of Plants, accompanied by a coloured plan. He proposed

First, To unite, in one whole, both the British and exotic arrangements, and yet to have them so distinctly separated that no confusion can be likely to arise. This apparent anomaly he proposed to accomplish by the *serpentine* walk marked in the plan, which forms the line of *separation* between the *blue* and *yellow* figures, representing the places of the orders upon it. The curves of this walk are so arranged as to afford the largest space of ground for the exotic side of the arrangement on the right, whilst the smallest portion of it, on the left of the same walk, is represented as being occupied by the British orders, all such being placed immediately *opposite* their *corresponding* orders on the exotic side.

Second, He proposed to enter the arrangement through an appropriate archway, on which the title of the division, sub-division, class, subclass, &c. may be painted, the same conspicuous marks to occur at each of the principal divisions of the system; also, that each order, on the exotic side of the walk, might be conspicuously named, and made complete as to *number*, so far as the system has as yet been developed, introducing specimens from the hot-houses in summer; and wherever this cannot be done, such orders to be simply marked in their places, by a reference on the labels to the stoves, &c. where the plants are to be found.

He also proposed to distinguish the plants in the British arrangement, that are *peculiar* to *Scotland, England* and *Ireland*, by appropriate distinctive marks upon the labels, as the *rose*, the *shamrock*, and the *thistle;* whilst the plants *common* to the *three countries* should have plain labels; thus presenting at one view, the peculiar Floras of each country respectively.

In the arrangement of the genera and species in

each order or family, he thought it desirable that they should be placed, the *tallest* in the *centre* of the *figure*, and dwarfing to the edge, placing the genera *most nearly allied*, in succession round each clump. Specimens of the *trees* or *shrubs* belonging to any order, might judiciously be placed in the grass contiguous to their *herbaceous* genera. He observed, that to the botanical student this method of displaying the interesting features of the *natural* system, would present many facilities, whilst to the man of taste, it could not fail to be equally interesting and pleasing, as presenting such a variety of grouping, and diversity of outline.

Dr. GRAHAM remarked, that the plan, though ingenious, was calculated to mislead, as it arranged plants in a linear manner, contrary to the real plan of nature. He conceived, at the same time, that it would be possible to dispose plants in a garden so as to give a more accurate representation of their natural affinities.

Mr. ROBERT BALL exhibited the *Pentacrinus Europeus*, and the *Beroe ovatus* from Howth.

Mr. BABINGTON informed the section of his having found *Isolepis Savii* in abundance in Anglesea, near Holyhead. Dr. GRAHAM said he found it also in Galloway, Scotland.

The *Orchis pyramidalis* was also found by Dr. GRAHAM at Galloway. Dr. KNAPP likewise found it growing in Fife. This species of orchis is common near Dublin.

Mr. BABINGTON said three species of the *Ranunculus* tribe were commonly confounded under one—the *aquatilis, palustris,* and *circinatus.* Mr. B. also informed the section that Reichenbach distinguished three distinct species under the head *orchis bifolia,* two of them natives of Great Britain; they were chiefly distinguishable by the form of the anthers, one being more round, the other longitudinal.

Rev. Dr. DRUMMOND stated the common *Gordius* to be viviparous; when put into the same vessel of water with a common newt, the animal became alarmed, and in a short time the *gordius* twined round it and killed it.

A communication was read from Mr. HAMILTON, of Mexico, offering his services to the British Association, in forwarding seeds and plants, and describing some new plants of that country, one a species of *Solanum.* The *amolle* was stated to be an *Agave.*

Dr. COULTER doubted this, and took occasion to inform the meeting of a plant, a species of *Veratrum,* (not the *Veratrum sabadilla* of the shops,) a portion of which was taken medicinally by a person labouring under dyspepsia so severely that he could make use of no food; after the second dose his appetite returned.—Doctor Coulter only saw the root, and was thus enabled to pronounce the plant not to be the *Veratrum sabadilla.* It is called by the natives the Indian's root.

Dr. Coulter is well known for his researches in South America, from whence he has just returned, after devoting many years to the elucidation of the natural history, the geology and geography of this immense tract of country, which has been all but a sealed book to the scientific world.

SECTION E.—ANATOMY AND MEDICINE.

DR. ABRAHAM COLLES IN THE CHAIR.

The room was crowded principally by Professional gentlemen.

Dr. GRAVES read rather an important paper on the use of Chloride of Soda in Fever. With regard to the time for its exhibition, and the species of fever in which it may be employed with advantage, he observed, that he had never given it except when the first stage is speedily followed by debility, and most commonly at a later period, when a depraved state of the secretions, petechiæ, or maculæ on the skin, and the well known group of symptoms are present, to which was formerly given the name of putrid fever, but which is now more generally called typhus. In inflammatory fever, in simple, continued, or nervous fever, he had never ordered this remedy; nor did he believe it to be of the least use in controlling the febrile excitement of ague or of hectic. Again, where fever is the consequence of some local inflammation, whether arising spontaneously or from an injury, the chloride of soda is quite inapplicable. Chlorine, pure and diluted, had been long used successfully as an external application and a disinfecting agent; but the internal exhibition of chloride of lime was not adopted until 1827, when it was tried by Dr. Reid. In 1832, he (Dr. G.) had commenced his observations on it, as an internal medicine. He was first induced to try it on an extensive scale, by the perusal of a very interesting pamphlet, written about three years ago by the Rev. Dr. Lawrence, the present archbishop of Cashel, a celebrated oriental scholar and an excellent chemist. He could now state

that the practice was attended with the greatest success. He (Doctor Graves) was no advocate of the doctrine that attributes all fevers to the existence of local inflammation, latent or evident; nor did he think there was a single physician of experience in Dublin, who was not convinced of the groundless and untenable character of such an hypothesis. With respect to the time for its exhibition, and the cases to which it is adapted, he observed, that when the early stage of fever is past, when all general and local indications have been fulfilled, when there is no complication with local disease, when the patient lies sunk and prostrated, when restlessness, low delirium, and more or less derangement of sensibility is present, when the body is covered with maculæ, and when the secretions from the skin and mucuous membranes give evidence of a depraved state of the fluids, it is then that the chloride of soda may be prescribed with the most decided advantage. The mode in which he prescribed it was in doses of from fifteen to twenty drops every fourth hour, in an ounce of water or camphor mixture. How it acts he would not pretend to explain; it was sufficient to say, that there was no remedy from which, in such cases, such unequivocal benefit is derived. It operates energetically, though not very rapidly, in controlling many of those symptoms which create most alarm. It seems to counteract the tendency to tympanitis, to correct the fœtor of the excretions, to prevent collapse, to promote a return to a healthy state of the functions of the skin, bowels, and kidneys; in fact, it appears admirably calculated to meet most of the bad effects of low putrid fever. In conclusion, Dr. Graves read a letter from Dr. Stokes, in which he stated his high approbation of the remedy from his experience of it, and pronounced it a most important addition to practical medicine.

Doctor Alison inquired, whether wine or any other stimulants were used during the time of its exhibition.

Dr. Graves replied in the affirmative; wine, stimulants, and nutriment were given with it, according to the exigencies of the case.

Dr. Houston next read a paper on the Peculiarities of the Circulating Organs in Diving Animals. Numerous beautiful preparations and drawings, illustrative of these modifications in the porpoise, seal, otter, gannet, great northern diver, &c. were laid before the Section, which placed the subject in a very clear light. Doctor Houston introduced his subject to the meeting by explaining the operation of the vital powers on the movement of the fluids through the body, and the ready influence of various mechanical agencies on the derangement of these motions; among which, it appears that none so much impede their progress as suspension of the function of respiration. He showed by a reference to experiments made by himself, and by reasoning on facts stated by others, that while breathing is suspended, the lungs in a great measure refuse transmission to the blood through their vessels, and this fluid, the source of life, becomes stagnant in the veins leading to these organs—a condition which, if continued beyond a certain period, is necessarily fatal to the animal. Dr. H. then proceeded to demonstrate that there is another powerful cause operating in retarding the course of the blood in animals when deeply submersed in the water, and which can never be felt by beings surrounded by atmospheric air—namely, a pressure on the exterior of the body increasing with the depth of the water, and tending to repel the fluids from the surface to the deeper recesses of the body. In illustrating this fact, Dr. H. observed, that a whale when struck with a harpoon, has descended perpendicularly, in five or six minutes, to the depth of an English mile, as shown by the length of the rope dragged after it, out of the whaler's vessel. Instances are even on record, where whales, under such circumstances, have broken their jaw-bones, and sometimes crown-bone, by the blow struck against the bottom at a depth of 7 or 800 fathoms. At such depths as this the pressure is enormous; and it is an interesting fact, that the first hint leading to a discovery of this principle in the ocean, arose out of a singular incident in whale fishing, which occurred in the observation of the elder Scoresby; and which, as it illustrates the subject under consideration, he begged leave to introduce. A whale, struck with a harpoon, dived rapidly out of sight, and when the rope of the harpoon was all drawn out, the boat, to which it was fastened, was dragged under water,—the crew meanwhile having escaped to a piece of ice. When the whale returned to the surface "to blow," it was killed, but immediately began to sink, which being an unusual occurrence, excited some surprise. Scoresby, who was looking on, threw the noose of a rope round the tail of the animal, which nevertheless continued sinking, until stopped by the last mentioned rope, which, when all expended, was near pulling the second boat under

water. Another rope was now let down, furnished at the extremity with a grapnel which fortunately hooked the rope belonging to the harpoon. The harpoon now lost its hold in the whale, which thereupon rose rapidly to the surface, leaving the sunken boat in connexion with the hook and ropes: Scoresby at first thought that the boat was entangled among rocks at the bottom of the sea, but he soon found that, by the assistance of about twenty men, it admitted of being raised, without, however, any lessening in weight as it neared the surface of the water. When fully dragged up, it required a boat at each end to keep it from sinking again, and was, with much difficulty, got into the ship. It appeared as completely soaked in every pore as if it had lain at the bottom of the sea since the flood; and a fragment of it, when thrown into the water, sank to the bottom like a stone.

From this incident, as important as it is curious in demonstrating the force of pressure by which the wood in a few minutes became so impregnated with water as to acquire a weight like that of a stone, a long train of very interesting experiments to ascertain the exact ratio of the weight of the sea, at different distances from the surface, were instituted by Scoresby, and afterwards by Perkins, from which it appears, among other things, that the weight increases with the depth, and that at a perpendicular depth of 2110 yards, the pressure on a cube of wood two inches in diameter exceeds that produced by a weight of twenty tons.

The consideration of this fact, as applied to the question of pressure on the body of a whale, at the same depth, strikes us with astonishment; for, if a square surface of sixteen inches sustains, under such circumstances, a weight of twenty tons, what must be the degree of pressure exerted on the body of an animal sixty or seventy feet long, by thirty or forty in circumference.

Under such powerful causes, operating in arresting the circulation of the blood, terrestrial animals could never exist for so long a period as it is well known those inhabiting the water are capable of. A whale can live without breathing for 20 minutes; the most expert diver has never been known to remain under water for more than two minutes. The provision which Doctor Houston pointed out as existing in those creatures in adaptation to the peculiar element in which they live, consists of large reservoirs in connexion with the veins leading to the lungs, where the obstruction occurs serving as temporary resting places for this fluid, in which it may remain for a time without bursting the vessels, or otherwise injuring the vital functions. A comparison drawn by Dr. Houston between the condition of the vessels in the gannet, which, though an aquatic bird, takes the fish on which it preys by pouncing on them when near the surface, and the diver which plunges after and seizes them deep in the water, afforded to the meeting a satisfactory illustration of the beauty and efficacy of the provision on which such differences in the habits of those birds depend.

At the termination of Mr. Houston's paper, an interesting conversation ensued.

Mr. Hargrave said, that with reference to the circulation in the human subject, he thought that the liver was occasionally used as a kind of diverticulum to relieve the heart and lungs in extreme cases. We are all aware of the great quantity of blood which is occasionally thrown on the liver. To this occurrence Mr. Hargrave was inclined to attribute the pain of the right side, felt after running or violent exercise. In such cases the action of the heart is not sufficient to get rid of the vast quantity of venous blood thrown upon it, and it accumulates in the liver. It was a common habit with persons who took exercise, in which they were obliged to run a great deal, to tie a bandage over the waist, and thus endeavour to support the liver, in its over-distended state, by means of mechanical pressure.

Professor Alison remarked, that the pain in such cases was not confined to the region of the liver, but extended across the epigastrium, and to the left hypocondrium to the region of the spleen.

Dr. Houston said, that in the venous congestion which accompanied the cold fit of an intermittent, the spleen was as much, or even more affected than the liver, being occasionally so much distended as to form a perceptible tumour in the abdomen.

Dr. Harrison, Mr. Adams, and Mr. Hart having each expressed their opinions,

Dr. Jacob, in reference to Mr. Houston's theory, gave it as his opinion, that we must look for some other cause than that assigned by Mr. H., and this cause Dr. Jacob considered to be connected with the suspension of respiration. It would appear that the existence of cells was a provision to

tunities of witnessing the gallantry, good conduct, and cheerful subordination of the Irish soldiery, under all the various and trying circumstances incident to the service: and I can bear ample testimony to the fact, that no men have deserved better of their country.

I fear you will consider me as having travelled out of my Record in touching upon Military matters; but the partiality which I entertain for my profession must plead my apology.

We have much to regret the absence of many of our enlightened members. At the head of this list, I should place the Bishop of Cloyne; and what embitters the consideration of his absence, is the reflection that it arises from illness. As I perceive we have been attacked in some of the periodical journals for making too long speeches at our Meetings; if I should address you at greater length, I fear I might render myself liable to become the subject of their sarcasm. I shall, therefore, conclude by moving, that the Rev. Dr. Lloyd, who is eminently known to you all, shall take the Chair as President. The learned Baronet sat down amidst loud cheering.

Dr. LLOYD, Provost of Trinity College, on taking the chair, addressed the meeting nearly as follows:—

My Lords and Gentlemen of the British Association—In offering my acknowledgments for the honor you have done me, by voting me into the chair at the meetings of the present year, I persuade myself that I shall not seem to set the less value on your favour, or on the high distinction it confers, if I express my conviction that I must owe this my present elevation to a circumstance which has long been deplored by the friends of science and humanity throughout this nation—I mean to the long continued illness of a truly revered prelate, to whom we had been accustomed to look up as to an eminent leader in the most arduous walks of science, and in those high walks ever to be seen among the foremost in the march of scientific discovery. There are no claims to your notice, which could have been advanced in my behalf, even by my most partial friends, which could have directed you to the choice you have made, but for the unhappy circumstance now alluded to. Those friends (I fondly hope) will feel, that they and the University have been complimented in the person of their aged academic superior. For myself, I can truly aver, that the honor you have conferred is one to which I never could have presumed to aspire; and that now it leaves me nothing further to wish for, except one thing, and one only, which is, that I were more deserving of so high a compliment.

Of the Association itself, its objects, and its construction, whereby it is fitted for the attainment of those objects, it must be unnecessary for me to offer any explanation in this assembly, wherein all this is so well understood: but it may not be so generally known, because it can scarcely be believed, that without those walls there are to be found individuals, though I hope not many, who regard your exertions with something like painful apprehension; finding themselves unable to reconcile the discoveries which have been made in a certain department of science, to which your attention is here invited, to their views of the Mosaic history. With these apprehensions it would be my wish to deal tenderly, if I could but learn how to respect them. I mean not to insinuate that such persons could propose to restrict the investigation of truth, in any of the avenues which may be supposed to lead to its possession; or that they could possibly think that we should suppress any of the discoveries which have been made, however alarming in their view of them; for this would be (to use the language of Bacon,) "*Deo per mendacium gratificari.*" But I do mean to assert, and I do assert it most confidently, that they are themselves to blame for that indigestion of which they complain. Happily, however, as their ailment has its source altogether within themselves, so also is the remedy within their own power; and if they would condescend to permit me to advise, I think I could help them with a prescription suited to their case. I would recommend that they should proceed with more patient circumspection, or at least, more of self-distrust and doubting humility, both in their interpretation of the language of the sacred historian, and in the inferences which they venture to draw from certain discoveries which have been made in geological science. It may be perceived that I suspect them of precipitancy in drawing conclusions from views hastily adopted: and as they may not be prepared to plead guilty to this charge, I would beg leave to ask them, have they indeed ascertained how far back the sacred historian had proposed to carry his readers in the communications he was commissioned to make. The answer, perhaps, will be, "to the origin of all things—to the creation of the universe." It is true that he prefaces his history of God's government over his chosen people, by informing us that "in the beginning, God created the heavens and the earth:" and it seems equally certain that he here speaks of the original creation of all things out of nothing. This indeed is a great subject; and though nothing circumstantial is here revealed to us concerning it, yet the sacred importance of the truth, assured to us by this single expression, is every way suited to the prominent place assigned to it; for it is nothing less than the authoritative statement of the first and fundamental article of all true religious faith. By it we are taught that self-existence is an attribute of the one Supreme Being, and that all things beside owe their existence to His unlimited power. How necessary it was to mankind to have an authoritative declaration on this subject, we may readily convince ourselves, by adverting to the errors into which the most celebrated men of all antiquity had fallen, who presumed to speculate on these matters so far beyond the reach of human reason, without other guidance. Among these

erroneous opinions, or rather among those wild conjectures, we find the following—that matter was eternal: that the Deity was the soul of the world; agreeably to which, the material frame of nature was to be regarded as his body, and not as his work: with many others equally presumptuous. Now in this his first sentence, the inspired writer settles definitively what we are to believe on this subject, by stating the primary relation which all things in common bear to the supreme Being; and with this information he forbears from mixing up any other matter. For it will be perceived that the statement is made without any specification of time or other circumstance; seemingly, because no addition of this kind could be of use in aiding our conceptions of a truth purely religious, or in strengthening our faith in the authority on which it was proposed; but chiefly because it was the sole object of the writer, in this first sentence, to claim for God the creation of all things whatsoever, and that this claim must remain unshaken, however we may decide on other questions which may be raised about the creation;—such as that relative to the time when it occurred; how long before the origin of the human race; whether all the parts of the universe were brought into existence simultaneously, or at different and widely distant epochs. It is plain then, that in this place the sacred writer furnishes no helps for the decision of such questions. Let us look to what follows. In proceeding to those arrangements by which the earth was to be fitted for the residence and support of man, and the other inferior tribes by which it was then to be tenanted, we find him describing its preceding condition: informing us that it was then "without form and void," and that "darkness was upon the face of the deep." Now, I confess that this always seemed to me very like the description of a ruined world: and if such was the earth at that time, it would be difficult to suppose that it had not existed long before. But this is not all. When he does come to the work of the six days, we find the description of each day's work introduced by an expression of a particular form, and concluded by another, by which it appears that the original work of creation, spoken of in the first verse, is excluded from the series of performances belonging to those days; and if excluded, then, perhaps, removed to an indefinite distance; for had it immediately preceded, we might naturally expect to find it spoken of, either as the work of the first of a series of seven days, or as part of the work of the first of the six days. This, then, would seem to remove the work of original creation far beyond that of the re-construction of the globe. It is true, that nothing is exhibited to our imaginations to mark the interval between these performances; but to deny that there was such an interval, and for that reason, would be to conclude about as wisely as the peasant, who supposes the clouds to be contiguous to the stars, because when looking up he discerns nothing between them. How then stands the case between the inspired writer and the men of science? From Moses it is collected by the most learned chronologers, that the human race has existed about six thousand years. According to geologists the race of man is coeval with the earth in its present form, and judging by the marks of age observable on the features of this latter, they are led to the same conclusion. Again; the geologists see reason to believe, that the globe, though in some different condition, is far more ancient than the races by which it is now inhabited, and the indications discoverable in the sacred records as far as they help to decide, are, as we perceive, in favour of this notion of its higher antiquity. But some persons may think, that the arguments here derived from the sacred records themselves are too weak to establish a coincidence so strict and so extensive. Be it so: we are under no necessity of pressing them to this extent. It is enough for us to show on the part of the cultivators of science, that they offer no contradiction whatsoever to the sacred historian; and on the part of the latter, that we have his free permission to explore the wonders of creation, for ascertaining whatever they may serve to ascertain; whether it be the antiquity of the globe, the various changes it may have undergone, or the different purposes which it may have been made to serve, before that it was fitted for and delivered over to its present inhabitants. All we ask for the inspired historian is, that he should not be required to exceed his commission in what he records for our instruction, or be interrogated on subjects altogether foreign from those of which it was his purpose to treat.

The same precipitancy is often to be found in the manner in which some men reason on those discoveries, which the gracious Author of our being has enabled us to make for ourselves among the works of his hands; and the same check is to be applied. Thus, admitting that geologists have discovered satisfactory proof of a fixed order of succession in many geological formations, and that they are enabled to judge with tolerable accuracy as to the time they would require for their accumulation by the forces now in operation, whether Neptunian or Volcanian; is it fair from this to conclude at once as to the time actually required; that is, as to the absolute age of these formations, or to ascribe to them an antiquity far greater than that of the human race? They may be of this antiquity, but it is not so established. For is it not reasonable to suppose that the forces concerned, though they should be the same in kind with those now in operation, must, in the beginning, have acted with indefinitely greater energy, than now that the appetencies of matter for matter have been so extensively satisfied, and the principles themselves have become comparatively inert by saturation, and consequently the forces with which they are endued reduced, as it were, to a condition of equilibrium? Shall we expect to find the same activity in a neutral salt as in its separate elements before chemical combination, or the same tendency to motion in a magnet, whether in or out of the magnetic meridian? Who can doubt that effects have been formerly produced on the most gigantic scale, in far less time than it would take to effect the most insignificant changes by the same forces, now become comparatively inert? It is not then because of the insufficiency of the period included within the Mosaic history

that any can feel themselves compelled to place certain formations, such as that of coal and many others, beyond the limits of that history; but because of the imbedded remains of plants or animals altogether different from any now in existence, or now existing in the same regions of the earth; or because of the number, and variety of the overlying formations indicative of successive epochs of destruction; for of such an occurrenee, on a large scale, Moses takes no notice, except in the matter of the general deluge; and of the extensive, I would rather say, of the universal dominion of the waters over the surface of the globe, there remain to us abundant monuments independently of those brought to light by that ornament of this Association, Dr. Buckland, and others.

What I insist on then is this—that when we seek God, through the indications of his power or his will, contained in his word or in his works, we should apply ourselves to the task with patient self-distrust and humble reverence amounting to religious awe. This is the frame of mind which becomes us when we would approach the Father of Lights—and I would add, that this is the frame of mind which every advance in the study of his works, no less than of his word, is fitted to produce. In fact, it is only the grossly ignorant who is insensible to his own ignorance. The more extensive our knowledge, the greater the number and variety of the subjects which present themselves for further inquiry. The wider the sphere of illumination, the more expanded is the surface which separates it from the regions of darkness; and the greater the extent of our intellectual domain, the more numerous the points in that boundary by which we are sensibly confined. This growing sense of our insufficiency adequately to comprehend the workings of Divine Power, serves but to increase the wonder excited by what is already brought within the compass of our discernment; and whilst man is humbled, God is exalted. Can we then fail to acknowledge with the illustrious Bacon, the religious uses of natural science, when in that glowing language so peculiar to himself, he thus expresses his convictions. "Philosophia naturalis, post verbum Dei, certissima superstitionis medicina est; eademque probatissimum Fidei alimentum. Itaque; meritô religioni donatur tanquam fidissima ancilla, cum altera voluntatem Dei, altera potestatem manifestat."

Perhaps nothing can be more just than this representation of the benefits to religion to be derived from the study of nature; yet I confess that I have been still more deeply impressed, and that, too, by a young gentleman of fashion, who, with myself, some thirty years ago, happened to join a party on a visit to the splendid gardens of the Dublin Society. On that occasion a remark was made by one of the company relative to the frailty of the objects which engaged our attention, and which was mistaken by him for disparagement. I was glad of the mistake, as it drew from him an expression which brought the truth home to my mind with so much power that I can never forget it. He replied that he was affected by what he saw, in a manner widely different; for that to him "it seemed that the earth we inhabit, with all its magnificent furniture, no less wonderful in its structure than splendid in its appearance, must have been made, not for human beings, but for gods." I cannot suppose that in this vast assembly, there is an individual who does not feel the truth as well as the force of this sentiment thus simply expressed, or one who does not perceive what great support it is fitted to afford to the Christian faith. For it will be observed that the opinions which secretly lie at the root of all infidelity are these—that man is not so bad, nor God so good, as the Gospel represents them. Now the latter of these opinions cannot for a moment withstand the force of the observation here alluded to; for it must naturally occur to every mind capable of the least reflection, that if such is the lavish bounty of the Creator to his creatures, in this their present state of alienation and hostility, there can be no *a priori* reason whatsoever, for suspecting that the promises of the Gospel, however magnificent, are delusive, which have been made to the same objects of his bounty, after that by the divine teaching they shall be fitted for their true enjoyment.

Now, I know it may be said, that all this may be very true, as well as much more that may be stated relative to the great advantages which flow from the cultivation of natural science in each of its numerous departments; but how does it prove the usefulness of this and the like associations, when after all, that which is to be learned or effected is the work of individuals, to be performed by them when separated from each other, often in their private laboratories or in their closets. And where, then, the necessity for calling on men to join these meetings, frequently, as it must be, from enormous distances, and at great personal inconvenience? This question I would beg leave to answer by another. How account for the fact confirmed by all experience, that those who have secured for themselves immortal honour by their successful labours in advancing the boundaries of science, have always appeared in groups, distinguishing the ages in which they lived, from those which preceded or followed, by their extraordinary brightness, like the numerous bands in some of your optical experiments? Truly the wave hypothesis does not furnish a more satisfactory explanation of this latter phenomenon, than the influence of example, and its force to awaken the dormant power of genius, does of the other; and this is the influence which we propose to strengthen by assembling together men who are engaged in the same or kindred pursuits. We know that a burning coal, when taken from among other combustibles, and abandoned to itself, slumbers, and perhaps becomes extinct; but when brought into contact with another combustible, they burn bright and strong by mutual influence, shedding light and heat on all around them. This I take to be an exact image of the effect of the communications and intercourse we have here established. How many hints are here thrown out during your discussions, which, when followed up, lead to the most important results? How many useful suggestions are here offered as to the mode of prosecuting particular discoveries, and how many are roused to exertion by the

intercommunication of kindred minds, and supported in their exertions by knowing that there are others who take an interest in their success? But if it were possible for a moment to overlook these great advantages, and if we were to value these meetings merely as affording the opportunities of rational recreation, I would still appeal to the lovers of science, and the admirers of those by whom it is extended, and I would ask them where or in what society can they hope to find the means of gratification so high, so ennobling, so heartfelt as that which they may here expect to enjoy? For myself, I can truly assert, that I know of nothing that could bribe me to withdraw my unworthy self from the rolls of this Association, or to deny myself the opportunities here so freely afforded of cultivating the personal friendships of those who have been heretofore the objects of my distant admiration; and that if this Association had nothing else to recommend it, but that it is the source of such high gratification, I should regard its declension as a ralamity to be greatly deplored. But this I say without any apprehension of such a result. The danger, if it had ever existed, has already passed. This Association has already exhibited too many and solid proofs of its usefulness ever to be slighted; it has left too many pleasing recollections ever to be abandoned.

Having concluded his address, the President called upon one of the Secretaries to present the Annual Report.

Professor HAMILTON then rose and read the following

ANNUAL ADDRESS.

It has fallen to my lot, Gentlemen, as one of your Secretaries for the year, to address you on the present occasion. The duty would, indeed, have been much better discharged, had it been undertaken by my brother secretary; but so many other duties of our secretaryship had been performed almost entirely by him, that I could not refuse to attempt the execution of this particular office, though conscious of its difficulty and its importance. For if we may regard it as a thing established now by precedent and custom that an annual address should be delivered, it is not, therefore, yet, and I trust that it will never be, an office of mere cold routine, a filling up of a vacant hour, on the ground that the hour must be some way or other got rid of. You have not left your homes—you have not adjourned from your several and special businesses—you have not gathered here to have your time thus frittered away, in an idle and unmeaning ceremonial. There ought to be, and there is, a reason that some such thing should be done; that from year to year, at every successive reassembling, an officer of your body should lay before you such an address; and in remembering what this reason is, we shall be reminded also of the spirit in which the duty should be performed. The reason is the fitness and almost the necessity of providing, so far as an address can provide, for the permanence and progression of the body, by informing the new members, and reminding the old, of the objects and nature of the association, or by giving utterance to at least a few of those reflections which at such a season present themselves, respecting its progress and its prospects; and it is a valid reason, and deserves to be acted upon now, however little may have been left unsaid in the addresses of my predecessors in this office. For if even amongst the members who have attended former meetings, and have heard those eloquent addresses delivered by former secretaries, it is possible that some may have been so dazzled by the splendour of the spectacle, and so rapt away by the enthusiasm of the time, as to have given but little thought to the purport and the use, the meaning and the function of the whole; much more may it be presumed that of the several hundred persons who have lately joined themselves as new members to this mighty body, there are some, and even many, who have reflected little as yet upon its characteristic and essential properties, and who have but little knowledge of what it has been, and what it is, and what it may be expected to become. First, then, the object of the Association is contained in its title; it is the advancement of science. Our object is not literature, though we have many literary associates, and though we hail and love as brethren those who are engaged in expressly literary pursuits, and who are either themselves the living ornaments of our land's language, or else make known to us the literary treasures of other languages, and lands, and times. Our object is not religion in any special sense, though respect for religious things, and religious men, has always marked these meetings, and though we are all bound together by that great tie of brotherhood which unites the whole human family as children of one Father, who is in heaven. Still less is our object politics, though we are not mere citizens of the world, but are essentially a British Association, of fellow subjects and of fellow countrymen, who give, however, glad and cordial welcome to those our visitors who come to us from foreign countries, and thankfully accept their aid to accomplish our common purpose. That common purpose, that object for which Englishmen, and Scotchmen, and Irishmen have banded themselves together in this colossal association, to which the eyes of the whole world have not disdained to turn, and to see which, and to raise it higher still, illustrious men from foreign lands have come, IS SCIENCE: the acceleration of scientific discoveries, and the diffusion of scientific influences.—And if it be inquired how is this aim to be accomplished, and through what means, and by what instruments and process, we as a body hope to forward science—the answer briefly is, that this great thing is to be done by us through the agency of the social spirit, and through the means, and instruments, and process which are contained in the operation of that spirit. We meet, we speak, we feel *together now*, that we may *afterwards* the better think, and act and feel *alone*. The excitement with which this air is filled, will not pass at once away; the influences that are now among us, will not (we trust) be transient, but abiding; those influences will be with us long—let us hope that they will never leave us; they will cheer, they will animate us still, when this brilliant week is over; they will go with us to our separate abodes, will attend us on our separate journeys; and whether the mathematician's study, or the astronomer's observatory, or the chemist's laboratory, or some rich distant meadow unexplored as yet by botanist, or some untrodden mountain top, or any of the other haunts and homes and oracular places of science, be our allotted place of labour till we meet together again, I am persuaded that those influences will operate upon us all, that we shall all remember this our present meeting, and look forward with

joyful expectation to our next re-assembling, and by the recollection, and by the hope, be stimulated and supported. It is true, that it is the individual man who thinks and who discovers; not any aggregate or mass of men. Each mathematician for himself, and not any one for any other, not even all for one, must tread that more than royal road which leads to the palace and sanctuary of mathematical truth. Each, for himself, in his own personal being, must awaken and call forth to mental view the original intuitions of time and space; must meditate himself on those eternal forms, and follow for himself that linked chain of thought which leads, from principles inherent in the child and the peasant, from the simplest notions and marks of temporal and local site, from the questions when and where, to results so varied, so remote, and seemingly so inaccessible, that the mathematical intellect of full-grown and fully cultivated man cannot reach and pass them without wonder, and something of awe. Astronomers, again, if they would be more than mere artizans, must be more or less mathematicians, and must separately study the mathematical grounds of their science; and although in this as in every other physical science, in every science which rests partly on the observation of nature, and not solely on the mind of man, a faith in testimony is required, that the human race may not be stationary, and that the accumulated treasures of one man or of one generation of men may not be lost to another; yet even here, too, the individual must act, and must stamp on his own mental possessions the impress of his own individuality. The humblest student of astronomy, or of any other physical science, if he is to profit at all by his study, must in some degree go over for himself, in his own mind, if not in part with the aid of his own observation and experiment, that process of induction which leads from familiar facts to obvious laws, then to the observation of facts more remote, and to the discovery of laws of higher orders. And if even this *study* be a personal act, much more must that *discovery* have been individual. Individual energy, individual patience, individual genius, have all been needed, to tear fold after fold away, which hung before the shrine of nature; to penetrate, gloom after gloom, into those Delphic depths, and force the reluctant Sybil to utter her oracular responses. Or if we look from nature up to nature's God, we may remember that it is written—"Great are the works of the Lord, sought out of all those who have pleasure therein." But recognising in the fullest manner the necessity for private exertion, and the ultimate connexion of every human act and human thought with the personal being of man, we must never forget that the social feelings make up a large and powerful part of that complex and multiform being. The affections act upon the intellect, the heart upon the head. In the very silence and solitude of its meditations, still genius is essentially sympathetic; is sensitive to influences from without, and fain would spread itself abroad, and embrace the whole circle of humanity, with the strength of a world-grasping love. For fame, it has been truly said, is love disguised. The desire of fame is a form of the yearning after love; and the admiration which rewards that desire, is a glorified form of that familiar and every-day love which joins us in common life to the friends whom we esteem. And if we can imagine a desire of excellence for its own sake, and can so raise ourselves *above* (well if we do not in the effort sink ourselves *below*) the common level of humanity, as to account the aspiration after fame only "the last infirmity of noble minds," it will still be true that in the greatest number of cases, and of the highest quality,

> Fame is the spur that the clear spirit doth raise,
> To scorn delights, and live laborious days.

That mysterious joy—incomprehensible if man were wholly mortal—which accompanies the hope of influencing unborn generations; that rapture, solemn and sublime, with which a human mind, possessing or possessed by some great truth, sees in prophetic vision that truth acknowledged by mankind, and itself long ages afterward remembered and associated therewith, as its interpreter and minister, and sharing in the offering duly paid of honor and of love, till it becomes a power upon the earth, and fills the world with felt or hidden influence; that joy which thrills most deeply the minds, the most contemptuous of mere ephemeral reputation, and men who care the least for common marks of popular applause or outward dignity—does it not show, by the revival, in another form, of an instinct seemingly extinguished, how deeply man desires, in intellectual things themselves, the sympathy of man? If then the *ascetics* of science—if those who seem to shut themselves up in their own separate cells, and to disdain or to deny themselves the ordinary commerce of humanity—are found, after all, to be thus influenced by the *social spirit;* we can have little hesitation in pronouncing that to the operation of this spirit must largely be ascribed the labours of ordinary minds; of those who do not even affect or seem to shun the commerce of their kind; who accept gladly, and with acknowledged joy, all present and outward marks of admiration or of sympathy, and who are willing, and confess themselves to be so, to do much for immediate reward, or speedy though perishing reputation. Look where we will, from the highest and most solitary sage who ever desired "the propagation of his own memory," and committed his lonely labours to the world, in full assurance that an age would come, when that memory would not willingly be let to die, down to the humblest labourer who was ever content to co-operate outwardly and subordinately with others, and hoped for nothing more than present and visible recompense, we still perceive the operation of that social spirit, that deep instinctive yearning after sympathy, to use the power, and (if it may be done) to guide the influences of which, this British Association was framed. Thus much I thought that I might properly premise, on the social spirit in general, and its influence upon the intellect of man; since that is the very bond, the great and ultimate reason, of this and of all other similar associations and companies of studious men. But you may well expect that in the short remaining time which your leisure this evening can spare, I should speak more especially, and more definitely, of this British Association in particular. And here it may be right to adopt in part a more technical style, and to enter more minutely into detail, than I could yet persuade myself to do, till I had eased myself in some degree of those overflowing emotions, which on such an occasion as this could hardly be altogether suppressed.—Presuming, therefore, that some one now demands, how this Association differs from its fellows, and what peculiar means it has of awakening and directing to scientific purposes the power of the social spirit; or why, when there were so many old and new societies for science, it was thought necessary or expedient to call this society also into being: I proceed to speak of some of the characteristic and essential circumstances of

this British Association, which contain the answer to that reasonable demand. First, then, it differs in its magnitude and universality, from all lesser and more local societies. So evidently true is this, that you might justly blame me, if I were to occupy your time by attempting any formal proof of it. What other societies do upon a small scale, this does upon a large; what others do for London, or Edinburgh, or Dublin, this does for the whole triple realm of England, Scotland, and Ireland. Its gigantic arms stretch even to America and India, insomuch that it is commensurate with the magnitude and the majesty of the British empire, on which the sun never sets; and that we hail with pleasure, but without surprise, the enrolment of him among our members, who represents the sovereign here, and is to us the visible image of the head of that vast empire; and the joy with which we welcome to our assemblies and to our hospitality, those eminent strangers who have come to us from foreign lands, rises almost above the sphere of private friendship, and partakes of the dignity of a compact between all the nations of the earth. Forgive me that I have not yet been able to speak calmly in such a presence, and on such a theme. But it is not merely in its magnitude and universality, and consequently higher power of stimulating intellect through sympathy, that this Association differs from others. It differs also from them in its constitution and details; in the migratory character of its meetings, which visit, for a week each year, place after place in succession, so as to indulge and stimulate all, without wearying or burdening any; in encouraging oral discussion, throughout its several separate sections, as the principal medium of making known among its members the opinions, views, and discoveries of each other; in calling upon eminent men to prepare reports upon the existing state of knowledge in the principal departments of science; and in publishing only abstracts or notices of all those other contributions which it has not as a body called for; in short, in attempting to induce men of science to work more together than they do elsewhere, to establish a system of more strict co-operation between the labourers in one common field, and thus to effect, more fully than other societies can do, the combination of intellectual exertions. In other societies, the constitution and practice are such, that the labours of the several members are comparatively unconnected, and few attempts are systematically made to combine and harmonise them together; so that if we except that general and useful action of the social spirit upon the intellect of which I have already spoken, and the occasional incitement to specific research, by the previous proposal of prizes, there remains little beyond the publication of transactions, whereby they seek as bodies to co-operate in the work of science. In them an author, of his own accord, hands in a paper; the title and subject are announced; it is referred to a Committee for examination, and if it be approved of, it is published at the expense of the society. This is a very great and real good, because the most valuable papers are seldom the most attractive to common purchasers, and because the authors of these papers are rarely able to defray from their own funds the cost of an expensive publication. There is no doubt that if it had not been for this resource, many essays of the greatest value must have been altogether suppressed, for want of pecuniary means. Besides, the approbation of a body of scientific men, which is at least partially implied in their undertaking to publish a paper, however limited and guarded it may be by their disclaimer of corporate responsibility, cannot fail to be accounted a high and honourable reward; and one, of which the hope must much assist to cheer and support the author in his toils, by virtue of the principle of sympathy. It is known, and (I believe) was mentioned in an address to this Association, at one of the former meetings, that the Principia and Optics of Newton, were published at the request of the Royal Society of London. Newton, indeed, might well have thought that those works did not need that sanction, if the meekness of his high faculties had permitted him to judge of himself as all other men have judged of him; but our gratitude is not therefore due the less to the Society whose request prevailed over his own modest reluctance, and procured those treasures for that and for every age. It must be added that the Royal and Astronomical Societies print abstracts of their communications, for speedy circulation among their members, which is a useful addition to the service done in publishing the papers themselves, and is an example well worthy of being followed by all similar institutions; and that the Royal Society has even gone so far as to procure and print, in at least one recent instance, (I mean in the case of a paper of Mr. Lubbock's) and perhaps also in some other instances, a report from some of its members, on a memoir presented by another, thus imitating an excellent practice of the Institute of France, which has probably contributed much to the high state of science in that country. This last procedure, and doubtless other acts of some other scientific societies, such as the discussions in the Geological Society, the lending of instruments by the Astronomical Society to its members, and the occasional exhibition of models and experiments by members to the body, in the Irish and other institutions, are examples of direct cooperation; and perhaps there is nothing to prevent such cases being greatly multiplied hereafter. But admitting freely these and other claims of the several societies and academies of the empire to our gratitude for their services to science, and accounting it a very valuable privilege to belong, as most of us do, to one or other of those bodies, and acknowledging that there is much work to be done which can only be done by them, we must still turn to this British Association, as the body which is *co-operative* by eminence.—The *discussions* in its sections are more animated, comprehensive and instructive, and make minds which before were strangers, more intimately acquainted with each other, than can be supposed to be the case in any less general body; the *general meetings* bring together the cultivators of all different departments of science; and even the less formal *conversations*, which take place in its halls of assembly during every pause of business, are themselves the working together of mind with mind, and not only excite but *are* co-operation. Express requests also are systematically made to individuals and bodies of men, to cooperate in the execution of particular tasks in science, and these requests have often been complied with. But more perhaps than all the rest, the reports which it has called forth on the existing state of the several branches of knowledge are astonishing examples of industry and zeal exerted in the spirit and for the purpose of co-operation. No other society, I believe, has yet ventured to call on any of its members for any such report, and indeed it would be a difficult, perhaps an invidious thing, for any one of the other societies or academies so to do. For such a report should contain a large and comprehensive view of the treasures of all the academies; and would it not be difficult for a zealous member of any one of them, undertaking the task at the request of his own body, to

form and to express that view with all the impartiality requisite? Would there not be some danger of a bias in some things, to palliate the defects of his own particular society, and in other things to exalt beyond what was strictly just, its true and genuine merits? But a body like the British Association which receives indeed all communications, but publishes (except by abstract) none, save only those very reports which it had previously and specially called for,—a body such as this and governed by such regulations may hope, that standing in one common relation to all the existing academies, and not belonging to the same great class of societies publishing papers, the members whom it has selected for the task may come before it to report what has resulted from the labours of all those different societies, without any excessive depression or any undue exultation, and in a more unbiassed mood of mind than would be possible under other circumstances. Accordingly the reports already presented by those eminent men who were selected for the office, (and rightly so selected, because a comprehensive mind was not less needed than industry,) appear to have been drawn up with as much impartiality as diligence; they comprise a very extensive and perfect view of the existing state of science in most of its great departments: and if in any case they do not quite bring down the history of science to this day, (as certainly they go near to do,) they furnish some of the best and most authentic materials to the future writer of such history. But we should not only under-rate the value of those reports, but even quite mistake the character of that value if we were to refer it all to its connexion with distant researches, and some unborn generation. They will, indeed, assist the future historian of science; but it was not solely, nor even chiefly for that purpose they were designed, nor is it solely or chiefly for that purpose which they will answer. They belong to our own age; they are the property of ourselves as well as of our children. To stimulate the living, not less than to leave a record to the unborn, was hoped for, and will be attained, through those novel and important productions. In holding up to us a view of the existing state of science, and of all that has been done already, they show us that much is still to be done, and they rouse our zeal to do it. Can any person look unmoved on the tablet which they present of the brilliant discoveries of this century, in any one of the regions of science? Can he see how much has been achieved, what large and orderly structures have been in part already built up, and are still in process of building, without feeling himself excited to give his own aid also in the work, and to be enrolled among the architects, or at least among the workmen? or can any person have his attention guided to the many wants that remain, can he look on the gaps which are still unfilled, even in the most rich and costly of those edifices, (like the unfinished window that we read of in the palace of eastern story), without longing to see those wants supplied, that palace raised to a still more complete perfection; without burning to draw fo·th all his own old treasures of thought, and to elaborate them all into one new and precious offering?—The volume containing the reports which were presented at the last meeting of the Association, has been published so very recently, that it is perhaps scarcely yet in the hands of more than a few of the members; some notice of its contents may therefore be expected from me now, though the notice which I can give must of necessity be brief and inadequate. I shall speak first of two reports, which may in a certain sense be said to be on foreign science. Science, indeed, as has been well remarked, is not properly of any country; but men of science are, and in studying the works of their brethren of foreign nations, they at once increase their own stock of knowledge, and cultivate those kindly feelings of general good will, which are among the very best results of all our studies, and of all our assemblings together. The first report of the volume, is that which Professor Rogers, of Philadelphia, has presented, at the request of the British Association, upon American Geology. The kindness of an eminent British Geologist, whose name would command attention if I thought myself at liberty to mention it, and whom I had requested to state to me in writing his opinion on this report, enables me to furnish you with a notice respecting its nature, which I shall accordingly read, instead of presuming to substitute any remarks of my own on the subject.

"The object proposed by Professor Rogers was to convey a clear summary of what had been ascertained concerning the geology of America, whether the knowledge acquired had been communicated to the public or not. This is not very different from the object contemplated by other reporters; but in the execution of the report it is found that a marked peculiarity arises. For the far greater portion of the report contains the result of Mr. Rogers' own reasonings on data, many of which appear for the first time in his essay. It has, therefore, more the character of a memoir than of an ordinary report. Were any one to adopt this plan in treating of the state of European geology he might be blamed, because the value of such a report would consist in the discussion of a vast mass of published data, and in the comparison of theoretical notions proposed by persons of high reputation. But in treating of America this was not the case; because, first, little authentic was known in Europe on the subject—second, there are few American authors of high repute in geology. This character of originality is certainly well supported by the author's own researches, and it is not surprising if his work contains some errors, still less remarkable that it should have excited some opposition at home. But the writer of the report has really taken much pains, has exhibited much patience, and has brought to his task a competent knowledge of European geology. It has certainly cleared our notions of the general features of American geology, and particularly augmented our positive knowledge of the more recent deposits, as regards organic remains, mineral characters, and geographical features. It is to be continued."

The other report which I alluded to, as almost entitled to be called a report on foreign science, is the report of the Rev. Mr. Challis on the theory of capillary attraction, which is a sequel to that presented at Cambridge on the common theory of fluids, and which the author proposes to follow up hereafter by another report on the propagation of motion as affected by the development of heat. Mr. Challis remarks, that while many questions in physics are to be resolved by unfolding through deductive reasoning the consequences of facts actually observed, there is also another class of questions in physical science, in which the facts that are to be reasoned from are not phenomena; for example, the fact of universal gravitation for which the evidence is inductive indeed, but yet essentially mathematical, the fact not coming itself under the cognizance of any of our senses, although its mathematical consequences are abundantly attested by observations. Mr.

Challis goes on to say—" The great problem of universal gravitation which is the only one of this class that can be looked upon as satisfactorily solved, relates to the large masses of the universe, to the dependence of their forms on their own gravitation, and the motions resulting from their actions on one another. The progress of science seems to tend towards the solution of another of a more comprehensive nature, regarding the elementary constitution of bodies and the forces by which their constituent elements are arranged and held together.—Various departments of science appear to be connected together by the relation they have to this problem. The theories of light, heat, electricity, chemistry, mineralogy, crystallography, all bear upon it. A review, therefore, of the solutions that have been proposed of all such questions as cannot be handled without some hypotheses respecting the physical condition of the constituent elements of bodies, would probably conduce by a comparison of the hypotheses towards reaching that generalization to which the known connexion of the sciences seems to point." The author finally remarks, that " Questions of this kind have of late largely engaged the attention of some French mathematicians, and the nature of their theories, and the results of the calculations founded on them, deserve to be brought as much as possible into notice." Acting upon these just views, Mr. Challis has accordingly performed, for the British Association and for the British public, the important office of reviewing and reporting upon those researches of Laplace, Poisson, and Gauss, respecting the connexion of molecular attraction, and of the repulsion of heat, with the ascent of fluids in tubes, which give to his report so much of that foreign character which I have already ventured to ascribe to it; yet, it is just to add, and, indeed, Mr. Chalis does so, that as Newton first resolved the mathematical problem of gravitation, in its bearings on the motion of a planet about the sun, and went far to resolve the same extensive problem in its details of perturbation also; he likewise first resolved a problem of molecular forces, and clearly foresaw and foretold the extensive and almost universal application of such forces to the mathematical explanation of the most varied classes of phenomena; and that the theory of capillary attraction, in particular, has received some very valuable illustrations in England from the late Dr. Thomas Young. I ought to mention that a very interesting report, on the foreign mathematical theories of electricity and magnetism, was read in part this morning to the mathematical and physical section, by the Rev. Mr. Whewell.

The next report after that of Mr. Challis in the volume, is the report I already alluded to, by Professor Lloyd, on the progress and present state of physical optics; respecting which I should have much to say, if I did not fear to offend the modesty of the author, and were not restrained by the recollection that he is a member of the same University with myself, and a countryman and friend of my own. I shall, therefore, simply express my belief, that no person who shall hereafter set about to form an opinion of his own on the question between the two theories of light, will think himself at liberty to dispense with the study of this report. I may add that it also, as well as that of Mr. Challis, draws largely from foreign stores; but if Huygens was the first inventor, and Fresnel the finest unfolder, and Cauchy the profoundest mathematical dynamician, of the theory of the propagation of light by waves; and if the names of Malus, and Biot, and Arago, and Mitscherich, and other eminent foreigners are familiar words in the annals of physical optics; we also can refer, among our own illustrious dead, to names enshrined in the history of this science—to the names of Newton, and Wollaston, and Young—and among our living fellow countrymen and fellow members of this Association, (unhappily not present here,) we have Brewster and Airy to glory of. It should be mentioned that the author of the report has himself made contributions to the science of light, more valuable than any one could collect from the statements in the report itself, and that important communications in that science are expected to be made during the present week, by Professor Powell, to a general meeting, and by Mr. Mac Cullagh to the physical section.

(The Secretary here read a notice, which he had procured from a scientific friend, of the Report by Professor Jenyns on Zoology; and afterwards continued his own remarks, as follows:)

The remaining Reports in the new volume are those by Mr. Rennie on Hydraulics; by Dr. Henry of Manchester, on the laws of contagion; and by Professor Clark of Cambridge, on animal physiology, and especially on our knowledge respecting the blood. Mr. Rennie's report contains, I believe, new facts from the manuscripts of his father, and is in other ways a valuable statement, industriously drawn up, of the recent improvements in the practice of hydraulics, to the theory of which science it is to be lamented that so little has lately been added: and without pretending to judge myself of the merits of the two other reports, I may mention them as compositions which I know to have interested persons, with whose professional and habitual pursuits they have no close connexion, and therefore, as an instance of the accomplishment of one great end proposed by our Association, that of drawing together different minds, and exciting intellectual sympathy. The other contents of the volume are accounts of researches undertaken at the request of the Association, notices in answers to queries and recommendations of the same body, and miscellaneous communications. Of these, it is of course impossible to speak now; your time would not permit it. Yet, perhaps, I ought not to pass over the mention of one particular recommendation which has happened to become the subject of remarks elsewhere—I mean that recommendation which advised an application to the Lords of the Treasury for a grant of money, to be used in the reduction of certain Greenwich observations, the result of which recommendation is noticed in the volume before us. In all that I have hitherto said respecting this Association, I have spoken almost solely of its internal effects, or those which it produces on the minds and acts of its own members. But it is manifest that such a Society cannot fail to have also effects which are external, and that its influence must extend even beyond its own wide circle of members. It not only helps to diffuse through the community at large a respect and interest for the pursuits of scientific men, but ventures even to approach the throne, and to lay before the King the expression of the wishes of this his Parliament of science, on whatever subject of national importance belongs to science only, and is unconnected with the predominance in the state of any one political party. It was judged that the reduction of the astronomical observations on the sun and moon, and planets, which had been accumulating under the care of Bradley and his successors, at the Royal and National Observatory of Greenwich, since the middle of the last century, but which, except so far as foreign astronomers might use them, had lain idle and useless till now, to the great obstruction of the advance of practical as well as theoretical

science, was a subject of that national importance, and worthy of such an approach to the highest functionaries of the state. It happened that I was not present when the propriety of making this application was discussed, so that I do not know whether the authority of Bessel was quoted. That authority has not at least been mentioned, to my knowledge, in any printed remarks upon the question, but as it bears directly and powerfully thereupon, you will permit me, perhaps, to occupy a few moments by citing it.

Professor Bessel of Koenigsberg, who, for consummate union of theory and practice, must be placed in the very foremost rank, may be placed perhaps at the head of astronomers now living and now working, published not long ago that classical and useful volume, the *Tabulæ Regiomontanæ*, which I now hold in my hand. In the introduction to this volume of tables, Bessel remarks, that "the present knowledge of the solar system has not made all the progress which might have been expected from the great number and goodness of the observations made on the sun, and moon, and planets, from the times of Bradley down. It may, indeed, be said with truth, that astronomical tables do not err now by so much as whole minutes from the heavens; but if those tables differ by more than five seconds now, after using all the present means of accurate reduction, from a well observed opposition of a planet (for example) their error is as manifest and certain now as an error exceeding a minute was, in a former state of astronomy—and the discrepancies between the present tables and observations are not uncommonly outside that limit. The cause is doubtful. Errors of observation to such amount they cannot be; and therefore they can only arise from some wrong method of reduction, or wrongly assumed elliptic elements or masses of the planets, or insufficiently developed formulæ of perturbation, or else they point to some disturbing cause, which still remains obscure, and has not yet been reached by the light of theory. But it ought surely to be deemed the *highest problem of astronomy*, to examine with the utmost diligence into that which has been often said, but not as yet in every case sufficiently established, whether theory and experience do really always agree. When the solution of this weighty problem shall have been most studiously made trial of, in all its parts, then either will the theory of Newton be perfectly and absolutely confirmed, or else it will be known beyond all doubt that in certain cases it does not suffice without some little change, or that besides the known disturbing bodies there exist some causes of disturbance still obscure." And then after some technical remarks, less connected with our present subject, Bessel goes on to say, "to me, considering all these things together, it appears to be of the *highest moment (plurimum valere)* towards our future progress in the knowledge of the solar system, to reduce into catalogues as diligently as can be done, according to one common system of elements, *the places of all the planets observed since* 1750, than which labour, I believe that no other now will be of greater use to astronomy." *(Quo labore nullum credo nunc majorem utilitatem Astronomiæ allaturum esse.)* Such is the opinion of Bessel; but such is not the opinion of an anonymous censor, who has written of us in a certain popular review. To *him* it seems a matter of little moment that old observations should be reduced. Nothing good, *he* imagines, can come from the study of those obsolete records. It may be very well that thousands of pounds should continue to be spent by the nation, year after year, in keeping up the observatory of Greenwich; but as to the spending £500. in turning to some scientific profit the accumulated treasures there, *that* is a waste of public money, and an instance of *misdirected influence* on the part of the British Association. For you, gentlemen, will rejoice to hear, if any of you have not already heard it, and those who have heard it already will not grudge to hear it again, that through the influence of this Association, what Bessel wished, rather than hoped, is now in process of accomplishment: and that, under the care of the man who in England has done most to show how much may be done with an observatory, that national disgrace is to be removed, of ignorance or indifference about those scientific treasures which England has almost unconsciously been long amassing, and which concern her as the country of Newton and the maritime nation of the world. For the spirit of exactness is diffusive, and so is the spirit of negligence. The closeness, indeed, of the existing agreement between the tables and the observations of astronomers is so great, that it cannot easily be conceived by persons unfamiliar with that science. No theory has ever had so brilliant a fortune, or ever so outrun experience, as the theory of gravitation has done. But if astronomers ever grow weary, and faintly turn back from the task which science and nature command, of constantly continuing to test even this great theory by observation, if they put any limit to the search, which nature has not put, or are content to leave any difference unaccounted for between the testimony of sense and the results of mathematical deduction, then will they not only become gradually negligent in the discharge of their other and more practical duties; and their observations themselves, and their nautical almanacs, will then degenerate instead of improving, to the peril of navies and of honour; but also they will have done what in them lay, to mutilate outward nature, and to rob the mind of its heritage. For, be we well assured that no such search as this, were it only after the smallest of those treasures which wave after wave may dash up on the shore of the ocean of truth, is ever unrewarded. And small as those five seconds may appear, which stir the mind of Bessel, and are to him a prophecy of some knowledge undiscovered, perhaps unimagined by man, we may remember that when Kepler was "feeling" as he said, "the walls of ignorance, ere yet he reached the brilliant gate of truth," he thus expressed himself respecting discrepancies which were not larger for the science of his time:—"These eight minutes of difference, which cannot be attributed to the errors of so exact an observer as Tycho, are about to give us the means of reforming the whole of astronomy." We indeed cannot dream that gravitation shall ever become obsolete; perhaps it is about to receive some new and striking confirmation; but Newton never held that the law of the inverse square was the only law of the action of body upon body; and the question is, whether some other law or mode of action, coexisting with this great and principal one, may not manifest some sensible effect in the heavens to the delicacy of modern observation, and especially of modern reduction. It was worthy of the British Association to interest themselves in such a subject: it was worthy of British rulers to accede promptly to such a request.

I have been drawn into too much length by the consideration of this instance of the external effects of our Association, to be able to do more than allude to the kindred instance of the publication of the observations on the tides in the port of Brest, which has, I am informed, been or-

dered by the French government, at the request of M. Arago and the French Board of Longitudes, who were stimulated to make that request by a recommendation of the British Association at Edinburgh. Many other topics, also, connected with your progress and prospects, I must pass over, having occupied your time so long; and in particular I must waive what, indeed, is properly a subject for your general committee—the consideration whether any thing can be done, or left undone, to increase still more the usefulness of this Association, and the respect and good will with which it is already regarded by the other institutions of this and of other countries. As an Irishman, and a native of Dublin, I may be suffered in conclusion to add my own to the many voices which welcome this goodly company of English, and Scottish, and foreign visitors to Ireland and to Dublin. We cannot, indeed, avoid regretting that many eminent persons, whose presence we should much enjoy, are not in this assembly; though not, we trust, in any case, from want of their good will or good opinion. Especially we must regret the absence of Sir David Brewster, who took so active a part in forming this association: but I am authorised, by a letter from himself, to mention that his absence proceeds entirely from private causes, and that they form the only reason why he is not here. Herschel, too, is absent; he has borne with him to another hemisphere his father's fame and his own; perhaps, from numbering the nebulæ invisible to northern eyes, he turns even now away to gaze upon some star which we, too, can behold, and to be in spirit among us. And other names we miss; but great names, too, are here: enough to give assurance that in brilliance and useful effect, this Dublin meeting of the Association will not be inferior to former assemblings, but will realise our hopes and wishes, and not only give a new impulse to science, but also cement the kindly feeling which binds us all together already.

Professor Hamilton having concluded his address, and the Presidents of the different sections having reported their proceedings, as given in the preceding analysis,

Professor SEDGWICK addressed the meeting in an animated and effective speech. He observed that the Association had now been in existence between four and five years, and being possessed of a migratory character, objections had been started, that the distance which it might be requisite to travel to the successive places of meeting and the occasional necessity of crossing the sea, might operate as a fatal check to the continued success of the undertaking. These anticipations were unfounded, and every succeeding meeting but proved the increased prosperity of the British Association. The Professor then adverted to the munificence of Sir John Tobin, in bringing over the members in his splendid steam vessel, and begged leave to move the thanks of the meeting to that gentleman, (loud cheering.)

Mr. MURCHISON seconded the motion, which passed amid the strongest evidences of satisfaction.

The Meeting adjourned at eleven o'clock.

MEETINGS OF THE ASSOCIATION, TUESDAY, AUGUST 11.

SECTION A.—MATHEMATICS AND PHYSICS.

Mr. WHEWELL resumed the portion of his very valuable report which had not been on Monday laid before the Section. The subject of the part now resumed was Heat. He reduced his subject to four heads.—1. The experimental evidence of the principles of the doctrine of heat. 2. An examination of certain difficulties which affect the fundamental equations. 3. The mathematical principles upon which their equations have been discussed; and 4. The application of these mathematical results to several subjects of practice and speculation. Under the first head, he began with Newton as the earliest experimental investigator, and gave the history of the law determined by him—viz. that when the temperature of a body exceeds that of the surrounding medium, if the times of cooling be taken in arithmetical progression, the reductions of temperature proceed by a geometrical series. It was soon found that this law was not exact, as it failed to give exact results when the temperature was very high, the rate of cooling being then faster than the law would indicate. It was also soon discovered that cold radiated as well as heat. The Professor then entered into a most interesting examination of the labours of Dulong and Petit; of Fourier, Poisson, and Cochet. He eulogized justly the sagacity with which Laplace and Biot first saw the difficulty, that the cooling of bodies depended in part upon their conducting power, while the heat was traversing the internal parts, as upon the radiating power, while thrown from the surface. This difficulty was solved by Fourier, who found that the quantity of heat thus conducted from particle to particle within the body, varied as the difference of temperature of the two directly and inversely as the distance at which they lay from each other. He also showed that the radiating intensity at the sur-

face of a body varied as the sine of the angle in which the ray met the surface. Professor Whewell then discussed the second head, but any attempt to give a clear view of the formulæ required for the mathematical discussion of the question, would be impossible within the limits to which we must confine ourselves. Under the third head, he entered upon an interesting comparison of the observed and calculated results, and showed the harmony that prevailed among them. But the fourth general head was the most popular portion of the report—"the application of these speculations to practically interesting cases." Amongst the numerous interesting topics discussed, the following are the most easily rendered intelligible. The sun, from day to day, is pouring upon the earth a quantity of heat: this, as it descends, by the conducting powers of the parts of the earth, follows certain laws of increase and decrease; and the entire quantity of each year descends to a certain depth, where it is succeeded by that thrown upon the earth in the preceding year, which had not yet been dissipated; below that lies the stratum occupied by the solar heat of the preceding year, and so on, until at length, at a certain depth, this solar heat ceases to be perceptible. He showed that the mean annual quantity of this solar heat was such as would melt fourteen metres of ice encircling the entire surface of the earth. He next considered the central heat of the earth, and the experiments and observations by which its existence was placed beyond doubt, and the law of its distribution, as it ascended to the surface, traced; and he stated that the issue from the surface at each part was so much in a century as would be capable of melting three metres of ice heaped upon that surface. He then discussed the subject of cosmical heat—showed the probability that the regions of space were not of a uniform temperature: and thence concluded that all the bodies of the solar system had a tendency to acquire the temperature of that part of space in which they are placed: and that the heat of the planetary spaces was only about 50° below the freezing point. The delivery of this report was listened to with deep attention and interest, and its conclusion greeted with much applause — the above is a very feeble sketch of its most prominent features.

Dr. Allman, Professor of Botany, next read a very interesting paper on a mathematical inquiry into the forms of the cells of plants. His views were illustrated by specimens of plants as well as by models of the geometrical solids: to us, one of the most interesting portions of this ingenious communication was that part in which he developed the mutual relations of the five solid forms, which, taken two and two, he denominated reciprocal solids, or such, as by slicing off the angles of one, would lead you to the bounding planes of the other. Thus, the tetrahedron is reciprocal to the tetrahedron alone; for the angles being equally sliced off, you will, by the slicing planes, be led to another body, contained by the three truncating triangular planes—the angles of the reciprocal corresponding to the sides of that to which it is reciprocal. The cube and the octohedron he also showed to be reciprocal; and, lastly, the dodecahedron, and icosahedron. This was the only part of the paper which came properly under the consideration of the Mathematical and Physical Section. The other very curious and interesting observations on the effect of compression in determining the forms of the cells of plants, were considered as rather coming within the province of the botanist and physiologist than of the mathematician; and, as much business yet remained for the day, Dr. Allman, at the request of the President, contented himself with stating some general views in conclusion.

Mr. Snow Harris was then called on by the President, and gave an interesting account of his views of electrical action and distribution. He first described some entirely new apparatus by which the most exact quantitative measures of the charges given to electrified bodies, were obtained, and the attractive forces exercised by them on each other, measured by weight. His unit measure of the quantity of electricity, thrown into a Leyden jar, struck us as peculiarly interesting. A very small jar is insulated, and its internal coating brought into connexion with the prime conductor of an electrical machine: from the wire thus connecting the inside coating, another wire stands at right angles, being carried by a small collar, by which it may be set higher up or lower down: a small knob of brass, on the end of this wire, can thus be brought nearer or farther from another small knob at the end of

another wire, connected with the outside coating of the small jar. This outside coating is then connected by a wire with the inside of a jar, into which it is intended to pour, as it were, a certain charge of electricity. The electrical machine being then put in motion, every time that the charge in the small jar reaches a certain intensity, a spark passes between the knobs, and the large jar receives a certain very small part of its charge; a second spark passing, adds as much more; a third as much more, and so on: so that, by counting the number of sparks, you can be certain of having exactly the same quantities in the jar when various experiments are tried; or you can throw in quantities in any desired proportion. A neatly fitted up balance on the other side of the instrument, with pieces of gilded wood of various shapes and sizes replacing one of its scale pans, furnishes the means of reducing to the indications of weight the several attractive forces excited by given electrical charges. The inventor performed a number of curious and interesting experiments with this instrument before the Section, by which he clearly proved certain laws of the action of electrified bodies, which, he conceived, were at variance with the results of Coulomb, and of the mathematical theories of electrical action. Mr Harris also described another delicate instrument, in which an index, mounted on friction wheels, was caused to traverse a graduated arc, by a pulley on its axis, one end of the silk thread round which carried the electrified body; at the other end a small counterpoising cylinder of varnished wood, which dipped into a vessel of water, acted as a means of estimating the force of attraction, by the alteration of the buoyant force of the fluid exerted upon it, as it became more or less immersed.

Professor Whewell highly eulogized the simplicity and beauty of the apparatus, and the ingenuity displayed in its use; he could not, however, help objecting to drawing conclusions adverse to the mathematical theory, from experiments, which, however simple they might appear, were yet very complex; the complexity chiefly resulting from the want of simplicity in the form of the surface of the attracting bodies. In the case of a number of particles arranged over an electrified plane, placed near a similar plane, any one of these particles would be drawn by each of the particles in the other plane, with a very different force, according to their relative situations; so that a differential equation must be first obtained by the law of the inverse squares of the distances, before the integral, which gives the law of the entire action, and which depends for its value essentially upon the form and dimensions of both surfaces, can be obtained.

Professor Stevelly stated that, in his opinion, Mr. Whewell and Mr. Harris were nearer to an agreement than they seemed to think; for if he had been able in his mind rightly to follow out the integration alluded to by Mr. Whewell, the integral would consist of two parts; one of which would b e proportional to the inverse square of the distance, and the other to the square of the quantity of the electrical charge; and these seemed to be the parts of the entire action, as established by the experiments of Mr. Harris.

Mr. Harris denied that, in the action of one electrified surface on another, each point of one was acted upon by every point in the other. He maintained, that the nearest particles alone influenced each other, and that all the actions took place in parallel lines; so that if two equal circles were suspended near one another, and exercised an electrical attraction, one of them only being electrified, you would not at all increase or diminish the amount of the attraction, by enlarging the non-electrified circle to any extent whatever.

The President then called on Dr. Reid, of Edinburgh, who read a very interesting paper upon Sound, particularly in relation to the precautions to be attended to in the construction of public buildings, in which lectures, sermons, or other discourses, were to be delivered. He drew the attention of the section to two distinct cases; the first, where, as in a church, the speaker is, for the most part, placed in one fixed position; the second, where, as in the Houses of Lords and of Commons, the speakers address the assembly from many various quarters. The author then gave some remarkable instances of the great distance at which sounds had been heard; one of the most curious of which instances was, that when the fleet engaged, we believe, in the blockade of Copenhagen, were in a very extended line, ships at the one end distinctly heard, and recorded in their logs, a loud cannonade which they heard on

a particular day; and it was found afterwards, by a comparison of the logs of the ships, that this very cannonade proceeded from the proving of large pieces of ordnance, which had been carried on for the greater part of a day at a dockyard in the neighbourhood of one end of the fleet, from which the other end, at which the reports were heard, was distant three hundred miles. He then showed how the reverberations of sound, from the ceiling, walls, and floor of a room, by being continued too long, and interfering with each other, would have the effect of producing a confusing noise, and thus interfering with the hearing of the succeeding parts of the discourse. From all the premises which he had previously laid down, he concluded, "that low roofs to buildings, and consisting of many planes set at various angles, rough and interrupted walls, and a floor either possessing very little resilience, such as earthen floors do, or, if boarded, then much broken and interrupted by irregular seating, produced a building best suited to the hearing of a speaker in many directions." He exhibited a plan of his own chemical laboratory in Edinburgh, in which these particulars were all exemplified; and he declared that a speaker expressing himself in a tone very little above a whisper, could be heard in the most remote parts of that room.—This communication was received with much applause, and many members of the section evinced their interest in the subject, by putting numerous questions to Dr. Reid, connected with the principles of acoustics.

Professor Stevelly gave a remarkable instance of the multiplication of reverberations, which could be observed, by clapping the hands at several places successively under the long piazza of the Library of Trinity College: also a peculiar whistling musical note, which was heard when a whip was cracked or the hands clapped at a small distance from iron railings, such as those about our squares, the effect arising from the succession of echoes from the equidistant rails.

Mr. Russell was then called on, and detailed to the Section, the origin and progress of the series of experiments on the resistance experienced at various velocities, by bodies moving through fluids at various rates. These experiments he was enabled to carry on upon a magnificent scale, by the liberal conduct of the canal companies of Scotland. The law of resistance most depended upon since the time of Newton was, that the resistance increased as the square of the velocity, and that this law did not cease until the velocity became very great. In this, however, the essential diversity of the circumstances of totally immersed, and of partially floating bodies, had been overlooked. The result which he experienced was, that the motion of a canal boat was more and more retarded up to a certain velocity; that at this velocity the resistance became a maximum; and that, beyond this, the velocity being increased, the resistance actually diminished, and consequently the force of traction required to keep up that velocity was less than the force of traction required to keep up a less; by which it happened that there was a velocity below which it would be less profitable for a ship or boat to be propelled, than any velocity above it—a circumstance, as he justly observed, of no little importance to our canal companies. This extraordinary effect he attributed to the wave excited in the canal by the motion of the boat; for this wave, once excited, can be shown, both by theory and actual experiment, to have a velocity quite independent of that of the boat, and depending solely upon the depth of the canal. This velocity is that acquired by a stone, or other heavy body, in falling down half the depth of the canal; so that, if the canal were twelve feet deep, the wave upon it would have constantly the very same velocity that a stone, if let fall from a height of six feet above the floor of a room, would strike the floor with. The velocity of this wave he in fact found to be the speed, beyond which the boat became less retarded; and the fact he accounted for, by supposing that the boat, at slower velocities, had as it were the hill arising from this wave constantly before it, but as soon as it reached this velocity it went forward, supported on the top of this wave along with it, while the fore part of the vessel was almost elevated out of the water. The conclusion of this communication was greeted with applause.

Dr. Robinson, the President, read a letter from Colonel Colby, accompanying a copy of the Ordnance Survey of the parish of Templemore, county of Londonderry, as a specimen of the grand national work now in progress.

Mr. Baggot of the Grand Canal Company, made some general observations in reference to Mr. Russell's theory, after which the Section adjourned.

SECTION B.—CHEMISTRY AND MINERALOGY.

The attention of this Section was some time occupied by Professor Davy's observations upon the protection of metals in salt water.

Professor GRAHAM read a paper on the constitution of certain salts, including the oxalates and carbonates. He adverted to his paper already published, in which he showed that the water, which many salts contain, acts sometimes as a base, and at others as a saline constituent, being replaced by salts, so as to form double salts. Mr. Graham illustrated this point by the gradual formation of the bin and quadroxalate of potash from the neutral oxalate, and by corresponding examples from the carbonates. He exhibited specimens of some double oxalates of great interest, particularly the oxalates of potash and chrome, and of potash and peroxide of iron. The beautiful crystallization of these salts was much admired. Professor Graham then discussed the action of ammonia on salts. He showed that the dry ammonia does not act as an alkali, but that it replaces and corresponds to the water of crystallization of these bodies in certain cases.

Dr. KANE stated that he felt highly gratified by the light thrown on the constitution of the salts by the researches of Professor Graham, and that he would take the present opportunity of occupying the Section for a few moments with some matters arising from Mr. Graham's observations. He (Dr. Kane) was glad to hear the popular (at least in this country) idea of the alkalinity of gaseous ammonia, so clearly and completely exposed, and would state an experiment which he had made, bearing upon it in an interesting manner. According to the view of the ammonia compounds supported by the continental chemists, the elements of an atom of water entered into the composition of its salts as an essential constituent. This is opposed to a statement of Sir Humphrey Davy's, which, if true, completely disproves the ammonium theory, and which has been copied into all chemical systems, even into that of Berzelius. Sir H. Davy states that the compact nitrate of ammonia contains less water than the prismatic form. Now the prismatic nitrate contains only the water by theory absolutely essential to the existence of the salt in any shape: but Dr. Kane found by careful experiments, that the prismatic, compact, and fibrous varieties of nitrate of ammonia could be all converted into each other without any loss of water; that in fact they differed in appearance and regularity of crystallization, but were the same in composition—all containing the elements indicated by the theory. Dr. Kane then adverted to the fact proved by Professor Graham, of ammonia replacing the water of crystallization of salts. He considers that fact peculiarly interesting, when taken in connection with the views lately proposed by Dumas, who considers ammonia as a sort of hydracid, consisting of a compound radicle ($N+2H$) united to hydrogen. He (Dr. Kane) mentioned many cases of the action of ammonia which favour this view, and stated that he had himself commenced an experimental investigation of the subject.

Professor JOHNSTON brought before the Section the subject of the constitution of the Mineral Chabasie, concerning which Sir David Brewster had remarked in Edinburgh last year, that it showed the superiority of optical over chemical or crystallographic characters, in determining the varieties of minerals. By optical analysis, chabasie is shown to be an aggregate of crystals, and not a simple mineral. Professor Johnston, however, demonstrated that we can arrive at the same result by chemical investigation; that in fact the chabasie which possesses these optical properties is an aggregate of pure chabasie with quartz; these minerals being almost isomorphous. By the superaddition of layers of these two bodies, which possess completely opposite influence on light, is generated the complex mineral which exhibits the curious differences of refractive action in different portions of it, as proved by Sir David Brewster, and described in the transactions of the last meeting.

Dr. DAUBENY, in reference to the disputed point between geologists and chemists, as to the sublimation of magnesia, made a communication to the effect, that in the neighbourhood of Mount Vesuvius specimens of carbonate of magnesia were found sublimed within the cavities of the lava. This statement was made on the authority of a gentleman who had seen the mass. The carbonate of magnesia found thus, was used by the druggists of Naples; he himself had seen a white coating under the surface of the lava, which, when analysed, he found to be carbonate of magnesia.

Mr. SCANLAN read a paper on a new fluid pro-

duct of the destructive distillation of wood. As a manufacturing chemist, he had been engaged for some time, amongst other chemical products, in making pyroxylic spirit, or spirit of wood, a fluid now used extensively in England, as a substitute for alcohol, in varnish-making, and improperly called Naptha by those who deal in and consume it. It differs from pyroxylic spirit and pyroacetic spirit; its boiling point is lower, and specific gravity higher than either of these fluids; it is a more powerful solvent of resinous substances than pyroxylic spirit or alcohol; it softens copal. When diluted with water, with which it is miscible in every proportion, there is diminution of volume. It is decomposed by caustic potash; acetate of potash being the result; and he suspects carbonate of potash to be also formed at the same time. Carbonate of potash separates water from this new fluid, if it had been previously diluted, the aqueous solution of carbonate of potash forming a distinct stratum at bottom. He stated that this fluid was not noticed by Dumas and Peligot, who had written an elaborate paper, in the Annales de Chimie, on pyroxylic spirit, in which they give a history of it, from its discovery by Taylor, up to the time of their own experiments. Mr. Scanlan presumes the rough pyroligneous acid, from which Dumas and Peligot obtained their wood spirit, did not yield the new fluid which he has obtained, for they state that on the addition of quick lime to their "rough product," abundance of ammonia is evolved, which is not the case with rough wood acid made in Dublin. He then proceeded to describe the apparatus he employs for the concentration of pyroxylic spirit, and figured it for the Section.

Dr. Dalton made some observations, which tended to throw some doubt on the separate existence of this, as a homogeneous fluid. He stated also, that the Manchester pyroligneous acid contained acetate of ammonia.

Dr. Apjohn gave it as his opinion, that it was a totally distinct substance from the pyroxylic spirit.

Professor Kane stated, that from the account of its properties, given by Mr. Scanlan, he was convinced that it differed very materially from pyroxylic spirit—particularly in the boiling point, in density, and in the action of caustic potash on it. However, in every one of these points, it resembles strongly the acetate of methylene; and he (Dr. Kane) was inclined to consider it as being that substance, probably containing impurities. He then pointed out some simple experiments, by which the nature of the substance could be completely determined, and suggested that Mr. Scanlan should make such experiments, and report the result to the Section by Friday.

It was proposed that Dr. Apjohn or Dr. Kane should join Mr. Scanlan in the experiments; but these gentlemen having declined, Dr. Dalton offered to do so.

Doctor Dalton made some observations on the volatile oil produced by the destructive distillation of caoutchouc, which he considered to be olefiant gas condensed into one-half its volume, and believed to be the illuminating principle of oil-gas.

SECTION C.—GEOLOGY AND GEOGRAPHY.

The Secretary read a letter from Lieut.-Colonel Colby, accompanying a copy of the Ordnance Memoir, descriptive of the barony and parish of Templemore, in the county of Derry. This was laid before the Geological Section as containing the first part of a minute survey of the mineral structure of the island, which it is intended to connect with the other branches of the Ordnance Survey.

Archdeacon Verschoyle read a paper on the trap dykes which occur in the counties of Mayo and Sligo, traversing those counties in a nearly east and west direction. The continuity of these dykes, though not actually visible, may be inferred by the appearance of detached portions in the various headlands and cliffs, arranged in regular lines. Archdeacon Verschoyle has examined eleven of these, all of which are parallel to each other. One passing through Knockri may be traced to Dromahaire in Leitrim, a distance from the sea on the west, where it commences, of more than sixty miles. Several exceed forty miles in length; and yet with such a horizontal extension, they are seldom more than forty feet thick. The effects of these dykes on the adjacent strata are such as might be anticipated from well known analogies. Contortions are frequent, and changes of structure equally so, quartz rock being altered to hyalite, and ordinary slates to siliceous schist.

Archdeacon Verschoyle also noticed the occurrence of trachyte in Killala Bay, and also of a peculiar conglomerate involved in trap. He then alluded to the possibility of the dykes of Down, proceeding as they do from the Mourne Mountains to the sea, being a continuation of those of Sligo.

Mr. GRIFFITH here alluded to a paper by Lieut. James, R.E., about to appear in the Journal of the Geological Society of Dublin, in which the Mourne dykes are described in detail; and though the subject had previously engaged the attention of Major Patrickson, yet as the Major himself forwarded Lieut. James's notes to the Society, considering them so full as to require no additional elucidation from his own, Lieut. James may fairly claim the merit of throwing much light on the subject.

Captain PORTLOCK remarked that the direction of dykes was very variable: those, for instance, of Fermanagh and Tyrone having more than a N. and S. direction.

Archdeacon VERSCHOYLE also mentioned that a system perpendicular to that described occurred in Mayo and Sligo.

Professor PHILLIPS now detailed the results of his enquiries into the geological distribution of fossil astacidæ, being part of a still more extended enquiry which he has undertaken, for the purpose of forming monographs of all British organic remains. Restricting the term to those species which may be fairly referred to the genus Astacus, Professor Phillips has extended the limited catalogues of preceding writers by describing 14 British species, all of which he has himself examined. Prefacing his remarks by a few general observations on the distribution of fossil crustacea, he stated that their remains were to be found in the mountain limestone, muschelkalk, oolites, greensand chalk, and tertiary strata; and those of the astacidæ in the strata from the muschelkalk to the chalk inclusive. Mr. Phillips pointed out the distinguishing characters afforded by the large didactyle claw at the extremity of the anterior legs and by the mode of division of the swimming tail of these crustacea. Mr. Phillips next considered the value of crustaceous fossils, as characteristics of particular formations; and having shown that whilst one species extended through the whole lias, another was confined to the Oxford clay; the range of some species being very great, of others very limited—he concluded, that though excellent guides to the determination of large groups, they could only be used with the utmost caution in the identification of minor subdivisions, and this more particularly as their distribution is in general local. Mr. Phillips concluded by remarking, that there is no perceptible improvement of organization in fossil crustacea, from the lowest to the highest strata, the resemblance to recent species being as close in one part as in another of the geological series; from which Mr. Phillips inferred that they afforded no argument in favour of the progressive development of organic *forms*.

Professor SEDGWICK, after expressing his admiration of the luminous elucidation of fossil crustacea which had been given by Mr. Phillips, dwelt with much humour on the bearing of the latter part of his observations on the principles of a certain school of foreign philosophers. He then maintained the efficiency of fossils as guides to a knowledge of stratification, and stated that he did not consider that opinion invalidated by the observations of Mr. Phillips.

Professor PHILLIPS explained that he only recommended caution in their use, more particularly in the determination of minor subdivisions, and that he was fully aware that some kinds of organic fossils were more marked in their distribution than others, and consequently better fitted for the identification of strata. He also pointed out that the true mode of using them was rather by considering through what strata two or more species were co-existent, than by looking at certain species as characteristic of peculiar formations.

Mr. GREENOUGH and Mr. MURCHISON added their testimony to the great merit of Professor Phillips's researches; and a general feeling of admiration was manifested by the Section at the profound and philosophic spirit which had attended and guided them.

The Section proceeded, as requested by Lieut.-Colonel Colby, to the Ordnance Survey Office, where they inspected the geological and mineralogical specimens collected as materials for the Ordnance Geological Survey of Ireland.

SECTION D.—ZOOLOGY AND BOTANY.

Colonel SYKES read a paper on the Geographical Range of Birds and Animals; in which he

pointed out the very close analogy, and in some cases probable identity of the Indian and European species, and expressed his doubts whether he had not erred in making some of his Indian birds distinct species from the European, and censured the disposition of many modern naturalists to separate varieties into distinct species. He distinctly shewed that very many birds and animals of the *same species now* exist, in mean temperatures, in different parts of the world, differing 40° of Fahrenheit. The facts he considered of importance, as bearing upon the question of the climate inhabited by the animals whose remains are now found in a fossil state.

Captain Ross stated that the crow, which is an Indian bird, is also found in Arctic America.

Dr. West exhibited to the Section a specimen of bog-yew, in which, from the non-adherence of two successive annual layers, the central portion of the heart-wood, though in close contact with the surrounding portion, which constituted the greatest part of the bulk of the tree, was throughout its whole extent perfectly distinct from it, so as to present the appearance of a small tree which had grown up through the centre of a large one, adapting itself completely to its cavity. He considered this singular phenomenon to be the result of a severe frost, which had either frozen a very thin layer of alburnum, so as to destroy its vitality, and thus prevent the next formed layer from adhering to it, or else without absolutely destroying it, had so affected its exterior as to produce the same result. He expressed a doubt whether this exactly answered to the lesion called by the French *gelivure;* and produced a drawing copied from one by Decandolle of a section of a juniper tree affected with that lesion, in which the diseased layer was of comparatively considerable thickness, whereas in his specimen there was no appearance whatever of a diseased layer, however thin, nor any space where such could have been. He alluded also to another lesion mentioned by Duhamel, called *roulure*, which consisted in the non-adherence of the annual layers, and so far appeared to have a greater resemblance to the case under consideration; but for want of a more detailed account, he did not venture to pronounce whether they were identical. He next entered into the consideration of how far the case might be urged in favour of the theory of Duhamel on the formation of wood, and against those of Decandolle and Du Petit Thouars; and remarked that at all events it showed that the bark can form wood independently of the aid of the alburnum. He farther adduced the fact, that the nodules of wood that are found on the trunk of the beech, have always a layer of libers interposed between them and the alburnum; and expressed his opinion that it afforded an additional proof that the bark has, in general, if not the sole, at least the predominant influence in the formation of wood.

Mr. Babington expressed his opinion that the nodules in beech are imperfectly developed buds.

Mr. Mackay submitted several specimens of bog-fir, sent by the Rev. Mr. Vignoles, from the Queen's County, where they were found eighteen feet under the surface: others were found immediately under those, three feet lower, and a third layer three feet still deeper in the bog. Several of the specimens had evident marks of their having been charred when they fell. He also detailed the uses made of bog timber in Ireland.

Colonel Sykes remarked, that he never saw any so much charred as the Irish specimens; he alluded to the fact of trees being found at different depths in Scotland, and spoke in terms of praise of an explanation of the phenomena given by Captain Portlock, with a drawing explanatory of the subject, in the Ordnance Survey of Templemore.

Dr. Jacob next submitted an interesting paper on the infra-orbital sinuses or *larmiers*, as they were called by the older French naturalists, in deers and antelopes; suggested by a recommendation of the Zoological Committee, at the Cambridge meeting, to investigate this subject. These sinuses are follicles or sacs capable of admitting the end of the finger, existing below the inner canthus of each eye. Dr. Jacob showed that they are not receptacles for the tears, as the term *larmier* implies: the gutter which exists in some from the eye to the cavity, being in many species inadequate for the passage of the tears, and the animal inspissated residuum, found in the sac, not being such as should remain after the evaporation of that fluid. He then explained the statements of the Rev. Gilbert White and Major H. Smith, that these sacs communicate with the nostrils, by showing that air may be without difficulty in those animals forced from the nostrils through the *puncta lachrymalia*, which those observers supposed to come through the sacs or sinuses, which are altogether im-

pervious. He observed, there can be little doubt that these sacs are follicles for the secretion of an odoriferous material, which enables the animal to distinguish the sex or species of other individuals, and for which similar secretions are provided in different parts of other animals, as on the side of the head in elephants, the back of the peccary, the face of certain bats, the belly of the musk, and the numerous præputial and anal glands of others. This is particularly exemplified by the existence of a peculiar black secretion, which exudes in large quantity from the infra-orbital sinuses in the antelope grimmea, and in the existence of solid masses, like indurated ear-wax, in old stags.

SECTION E.—ANATOMY AND MEDICINE.

Dr. PRICHARD was in the chair the first half, and PHILIP CRAMPTON, Esq. the second half of this day.

The Section was remarkably well attended. The first communication was an able and elaborate report, from a committee of several medical gentlemen in Dublin, who had been requested, at the meeting of the Association in Edinburgh, to institute a series of experiments to ascertain the precise motions of the heart, as also the cause of the different sounds which are audible when the ear or the stethoscope is applied to the vicinity of this organ, or of some of the large vessels. Professsor Harrison read this report; it detailed the several experiments which were most carefully conducted, the subjects of which were generally young calves; in which animals the heart is sufficiently large to admit of the motions and sounds being accurately observed. The animals were prepared in the following manner:—a tube connected with a pair of bellows was inserted into the trachea, and the sensibility of the animals having been destroyed by a blow on the forehead, artificial respiration was commenced, by means of which the heart was enabled to continue its pulsations for a period varying in different subjects from one hour to two. The Committee had, however, been disappointed in their endeavours to procure some of the woorara poison, which has been used in similar experiments in London; and found, that the employment of prussic acid, in a quantity sufficient to suspend the sensibility of the animal, destroyed, in a few minutes, the power of motion in the heart. In respect to the motions of the heart, they confirmed the ancient opinions which, within these few years, had been, in some measure, invalidated by the writings of some modern physicians, but which are now considered as erroneous. In respect to the sounds which are heard during the heart's action, they are two in number—the *first* and *second*—the FIRST was attributed to the contraction of the ventricles on their contents, and the SECOND to the recoil of the blood against the semi-lunar valves of the aorta and pulmonary artery.

After detailing a number of experiments, the report concluded thus:—"From the experiments on the sounds of the heart, it appears to follow: 1. That the sounds are not produced by the contact of the ventricles with the sternum or ribs, but are caused by motions within the heart and its vessels. 2. That the sternum and front of the thorax, by their contact with the ventricles, increase the audibleness of the sounds. 3. That the first sound is connected with the ventricular systole, and coincides with it in duration. 4. That the cause of the first sound is one which begins and ends with the ventricular systole, and is in constant operation during the continuance of that systole. 5. That it does not depend on the closing of the auriculo-ventricular valves at the commencement of the systole, because such movement of the valves takes place only at the commencement of the systole, and is of much shorter duration than the systole. 6. That it is not produced by the friction of the internal surfaces of the ventricles against each other, as such friction cannot exist until the blood has been expelled from the ventricles, whereas the first sound commences with the beginning of the ventricular systole. 7. That it is produced either by the rapid passage of the blood over the irregular internal surfaces of the ventricles, on its way towards the mouths of the arteries, or by the *bruit musculaire* of the ventricles, or probably by both these causes. 8. That the second sound coincides with the termination of the ventricular systole, and requires for its production the integrity of the semilunar valves of the aorta and pulmonary artery, and seems to be caused by the sudden check given by the action of these valves to the motion of the columns of blood driven towards the heart after each ventricular systole by the elasticity of the arterial trunks."

In concluding the Report, the Committee expressed their opinion, that although much light has been thrown on the subject of the Motions and Sounds of the Heart, by recent investigations, here and elsewhere, the nature of the inquiry is such as renders it difficult in many instances to arrive at

satisfactory conclusions. They also thought that the subject, from its importance, whether in a practical view, or as an object of philosophical inquiry, was deserving of further investigation.

The thanks of the meeting having been voted to the Committee,

Dr. Williams stated the result of several experiments, made by himself, on the subject then before the Section. Some of the details mentioned by the Committee were confirmatory of these results, others not. In conclusion, he mentioned that he was at present engaged in a series of pathological experiments and observations, from which he expected to be able to throw much additional light upon the subject. In the pursuit of these inquiries, he would recommend an attentive study of the laws of sound, a matter which had been hitherto much neglected.

Dr. Graves said that he thought the meeting was in a fair way of obtaining much valuable information. He would therefore suggest that the members of the Committee should take up the subjects individually, and apply themselves to the various points of difference between them and Dr. Williams, in order to show in what they differed and in what they agreed.

Mr. Dick of Edinburgh expressed himself highly gratified with the very able Report of the Committee, but there were some circumstances in that report which did not accord with his experience. Having mentioned some of his objections,

Dr. Green asked what facts had Mr. Dick to prove that the impulse of the heart was caused by the dilatation of the ventricles? The Committee were prepared with proofs to show that the impulse accompanied their contraction.

Dr. Corrigan said that a series of experiments performed by himself and Dr. Hunt, some years back, were among the first undertaken with the view of illustrating the points in question. The difficulties attendant on this subject were very great; experiment after experiment had been performed, without arriving at a satisfactory explanation. Having taken up the various arguments, he concluded by stating, that there were some points on which he agreed with the Committee, but with respect to the cause of the first and second sounds of the heart, he did not think their experiments conclusive.

Dr. Carson, of Liverpool, Dr. Greene, Dr. E. Kennedy, Mr. Hargrave, Mr. Carlile, and Dr. Williams, having expressed their sentiments on the subject,

Dr. Alison of Edinburgh observed, that there was a remarkable coincidence between the results of many of the experiments made here and in London. Both parties were very nearly agreed as to the motions and the cause of the second sound; and even with respect to the first, they were partially agreed, as they had acknowledged the agency of the same cause in its production. He concluded by moving the thanks of the meeting to Dr. Williams.

Dr. Harrison, in seconding the motion, said, as a member of the Committee, he felt pleasure in observing these coincidences. As the discussion, however, had ran so far, he would suggest its postponement for the present.

The motion having been put from the Chair, and carried unanimously,

Mr. Hart read a letter from the Edinburgh Committee appointed to inquire into the motions and sounds of the heart, regretting that they would not be able to furnish their Report until the next meeting of the Association.

The next paper was a report read by Dr. Alison from a committee which was appointed in Edinburgh to inquire into the propriety of establishing a general registration of deaths in Scotland. This report contained many valuable practical suggestions on the subject of a general registry, and of its utility, not merely in relation to medicine, but to the general purposes of society. The Section, we understand, afterwards recommended to the Council of the Association, the appointment of a similar committee, and for similar purposes, in this country. At three o'clock the Section adjourned, and at the evening meeting in the Rotunda the proceedings were briefly stated by Professor Harrison.

SECTION F.—STATISTICS.

The section-room this day was crowded, and several ladies attended, in consequence of its being known that a report would he presented on the question of Education. Mr. Langton, of Manchester, read a report on the state of education in that town, which proved the inaccuracy of the returns made to the House of Commons on the Earl of Kerry's motion. He stated that at a meeting of the Statistical Society on the 23d April, 1834, a committee was appointed to examine into the state of the Day, Sunday, Charity, and Infant Schools in the borough of Manchester, and to report on the number of children contained in them,

and the nature and efficacy of the instruction there received.

It appears that the numbers at present attending the different schools in the borough of Manchester are 43,304: of whom

10,108 attend day and evening schools *only*.
10,011 attend both day and Sunday schools.
23,185 attend Sunday schools *only*.

The population of the borough being at present probably 200,000, the above number of persons receiving instruction of some kind or other is 21.65 per cent. of the total population. Of those attending day and evening schools the numbers give about 10 per cent.

Perhaps the comparative number of those under course of instruction may be more clearly seen in the following statement:—

It appears from the inquiry that there are about 33,000 scholars on the books of Sunday schools. About 10,000 are returned as attending both Sunday schools and day or evening schools.

Thus 23,000 scholars receive Sunday school instruction *only*.

About 20,000 are returned as day and evening scholars.

Thus about 43,000 is the total number of children under course of instruction.

Deducting 10,000 for scholars under five and above fifteen, which is probably somewhat less than the truth.

About 33,000 are left as the number of children between the ages of five and fifteen, under course of instruction. The whole number of children between the ages of five and fifteen in the borough of Manchester being estimated at 50,000, (or 1-4th of the whole population), it would thus appear that about 2-3rds of this number are educated, and that 1-3rd are receiving no instruction whatever.

As an instance of the inaccuracy in the parliamentary returns, he mentioned that, in the township of Manchester alone, which contains a population of 142,000, there are entirely omitted, in these returns, 1 infant school, 10 Sunday schools, and 176 day schools, which existed at the period these returns were made, and contained 10,611 scholars. False returns were made by one individual of 3 Sunday schools that never existed at all, and which were stated to contain 1,590 scholars; and double returns were made of three other schools, containing 375 scholars, so that the total error in these returns for the township of Manchester alone was 181 schools and 8,646 scholars. Besides this, eight dame schools were reported as infant schools.

He minutely described the state and condition of the dame schools, which are generally found in dirty unwholesome rooms, damp cellars, or dilapidated garrets.

"One of the best of these schools is kept by a blind man, who hears his scholars their lessons, and explains them with great simplicity; he is however, liable to interruption in his academic labours, as his wife keeps a mangle, and he is obliged to turn it for her."

The state of the Common Day Schools is even worse:

"The masters themselves have generally a better opinion of their own qualifications for their office. One of them observed, during a visit paid to his school, that there were too many schools to do any good, adding, 'I wish government would pass a law, that nobody but *them as is high larnt* should keep school, and then *we* might stand a chance to do some good.'

"Most of the masters and mistresses of these schools, seemed to be strongly impressed with the superiority of their own plans to those of any other school, and were very little inclined to listen to any suggestions respecting improvements in the system of education that had been made in other places.—'The old road is the best,' they would sometimes say. One master stated, that he had adopted a system which he thought would at once supply the great desiderata in education—'it is simply,' he said, 'in watching the dispositions of the children, and putting them especially to that particular thing which they take to.' In illustration of this system, he called upon a boy about ten years of age, who had *taken to* Hebrew, and was just beginning to learn it: the master acknowledging that he himself was learning too, in order to teach his pupil. On being asked whether he did not now and then find a few who did not *take to* anything, he acknowledged that it was so; and this, he said, was the only weak point in his system, as he feared that he should not be able to make much of those children.

"One of these masters, who was especially

conscious of the superior excellence of his establishment, as soon as he was acquainted with the object of the visit, began to dilate upon the various sciences with which he was familiar; among which, he enumerated Hydraulics, Hydrostatics, Geography, Geology, Etymology, and Entomology. It was suggested to him that they had better, perhaps, take the list of queries in their order. On coming to the subjects taught in the school, he was asked—Do you teach Reading and Writing?—Yes! Arithmetic?—Yes! Grammar and Composition?—Certainly! French?—Yes! Latin?—Yes! Greek?—Yes, yes! Geography?—Yes, &c.; and so on, till the list of queries was exhausted, answering every question in the affirmative. As he concluded, the visitor remarked, 'This is *multum in parvo* indeed,' to which the master immediately replied, 'Yes, I teach that; you may put that down too.'

"In one of the seminaries of learning, where there were about 130 children, the noise and confusion was so great, as to render the replies of the master to the inquiries put to him, totally inaudible; he made several attempts to obtain silence, but without effect; at length, as a last effort, he ascended his desk, and striking it forcibly with a ruler, said in a strong Hibernian accent, 'I'll tell you what it is, boys, the first I hear make a noise, I'll call him up, and kill him entirely;' and then perceiving probably on the countenance of his visitor some expression of dismay at this murderous threat, he added quickly in a more subdued tone, 'almost I will.' His menace produced no more effect than his previous appeals had done. A dead silence succeeded for a minute or two; then the whispering recommenced, and the talking, shuffling of feet, and general disturbance was soon as bad as ever. The master gave up the point, saying, as he descended from his desk, 'You see the brutes, there's no managing them!'

"The Committee met with two instances of schools kept by masters of some abilities, but much given to drinking, who had, however, gained such a reputation in their neighbourhood, that after spending a week or fortnight in this pastime, they could always fill their school-rooms again as soon as they returned to their post. The children, during the absence of the masters, go to other schools for the week, or play in the streets, or are employed by their parents in running errands, &c. On another occasion, one of these instructors and guardians of the morals of our youth, was met issuing from his school-room at the head of his scholars to see a *fight* in the neighbourhood; and instead of stopping to reply to any educational queries, only uttered a breathless invitation to come along and see the sport."

The schools attached to the Mechanic's Institute, the Infant Schools, and the Sunday Schools, are highly praised; but the examiners report, that in the Lancasterian Schools, the plan of instruction is too mechanical, and the general cultivation of the mental powers is often wholly neglected. The general results of the Committee's inquiries were then stated, and most of them are of the highest importance. While parliamentary committees are engaged in investigating the state of education both in England and Ireland, the public attention cannot be too strongly directed to the facts ascertained by the labours of this committee. The following conclusions especially deserve notice:—

"That the number of children returned as attending different schools, affords a very imperfect and fallacious criterion of the real state of education in any town or district where such returns are made.

"That the thing most to be wished for children of this early age, is that Infant Schools should gradually supplant the old Dame Schools, and be established on so large a scale throughout every part of the borough, as to afford accommodation for all the children of an age to receive instruction there.

"That of the children who attend the common Day Schools, amounting to nearly 7000, the greater part receive an extremely poor education, scarcely meriting the name—that this is owing chiefly to the ignorance and incapacity of the masters who conduct them—and that no effectual means can be taken to render these schools efficient, until proper seminaries are established for the instruction of the teachers themselves, and till the idea is exploded that the task of education is the only one for which no previous knowledge or qualification is required.

"That while in Prussia, and several of the German states, all children of every class, between the ages of seven and fourteen, are obliged

by law to attend school; and it is shown by statistical returns, that they actually do so: it appears by this Report, that in Manchester, not quite two-thirds of those between the ages of five and fifteen receive even nominal instruction."

Several valuable tables were appended to the report, which confirmed the various statements.

The Rev. Dr. DICKINSON said, that the subject of educating masters had engaged the anxious attention of those who presided over the institutions for public instruction in Ireland. It had been practised on a limited scale with the best effect, by the Kildare-place Society, and the Association for discountenancing Vice. The Board of Education recently established, had also taken a large establishment, in which it was proposed to educate four hundred teachers, for the use of their schools. When the system came into full operation, it was designed to send round examiners, who should select boys qualified by moral and literary merit to undertake the charge of schools, and this plan promised not only to insure a good supply of masters, but to afford a stimulus to exertion in all the schools throughout the country. This system will be in operation next year. He eulogized the present model school in Merrion Street, and bestowed high praise on its master, Mr. Macarthy. He stated, that the boys had a kind of game of puzzles, taking rank according to their answering questions put to each other, and that the excitement of this game induced many of them to devote their evenings to study. He added, that the quantity of miscellaneous information thus acquired could scarcely be credited.

The Rev. E. G. STANLEY said, that he had recently made a tour in the west of Ireland, and could bear personal testimony to the great anxiety felt by the Irish, for the spread of education. He had gone into many of their schools, and had always been received unsuspiciously and kindly. In general he found the quantity and quality of instruction above the common average of England. He could not forbear mentioning with pleasure, the sound and scriptural answers made to him by the boys he examined, in a school exclusively Catholic.

Mr. LANGTON dwelt strongly on the incorrect conclusions, respecting the state of education, that had been founded on the population returns. In the report of 1818, the clergymen of Manchester, not only omitted all notice of the schools kept by Dissenters, but even many of the schools under their own guidance. Consequently, Lord Brougham's statement of the great advance of education, during the last seventeen years, was fallacious.

A portion of Mr. W. R. GREG's report, on the 'Social Statistics of the Netherlands,' compiled on the model of Guerry's 'Moral Statistics of France,' was read. As this valuable communication may be more advantageously analyzed when completed, it will be sufficient here to state, that the part selected, referred to Crimes and Prison Discipline, which led to a long and interesting debate.

Dr. CLELAND's paper, on the Glasgow Bridewell, was then read by the Secretary.

It stated, that, "in the year 1635, a House of Correction was fitted up in this city for dissolute females; but it was not till 1798 that the citizens of Glasgow had a regular Bridewell. In 1824, it was found that this building had become inefficient in accommodation and other requisites; to remedy which, 13,680 square yards of ground were acquired in Duke Street, on which the present Bridewell for the city and county was erected, on the radiating principle, capable of being afterwards extended.

"In the old building, the cells are on each side of a corridor or passage, but in the new there is only one row of cells entering from the corridors. These buildings contain 275 cells—viz. in the old, now used as a prison for females, 115, each 8 feet 6 inches long, by 6 feet 7 inches wide, each containing 462 cubic feet of space; and in the new building, used as a prison for males, 160, each 9 feet long by 7 feet wide, each containing 630 cubic feet. In the centre building there is a chapel and ample accommodation for the Governor's family.

"It appeared from the statement, that (besides the sum of £116. 5s. 3d. paid to inmates,) the produce of the work performed during the year maintained all the prisoners, with a surplus of £401. 14s. 11d., which surplus goes to lessen the expense of repairs on the buildings, and the salaries and wages.

"During the year, there have been (exclusive of 356 that remained 2d August, 1833,) 1967

persons committed, and 2030 liberated, leaving 293 in confinement on 2d August, 1834. The whole deficiency, amounting to £590. 10s. divided by 1967, the number committed, shows that the net expense to the public for every committal, is no more than 6s., the average period of residence being 59½ days.

"The prisoners work 12 hours daily; about one half of them sleep in hammocks in the cell where they work; the other half have separate sleeping cells. The working cells are lighted with gas, and the whole are furnished with every necessary. Each prisoner, in rotation, if his sentence exceed 60 days, has the privilege of one hour every day for air and exercise in the corridor adjoining his cell."

In conclusion, Dr. Cleland observed—"My remarks have arisen out of the observation and experience of upwards of thirty years; during which time I have visited numerous prisons in the United Kingdom, and have been officially connected with those in Glasgow, either as a visitor, or as a city or county magistrate.

"Much has been said about classification, and latterly an experiment on the silent system has been introduced into some of the English Houses of Correction, and, probably, with good effect, where the formation of the prison does not admit of solitary confinement, but I am firmly of opinion that no classification nor silent system, however well managed, can be equal to solitary confinement."

Mr. Halswell related some curious facts to prove that really solitary confinement, including exclusion from the light, was of such a nature that no man could endure it for more than ten days. He would recommend in place of it, separate confinement, by which contamination might be prevented.

A Member was of opinion that solitary confinement could be endured for a length of time. He admitted that some change was required in the government of gaols, in order to introduce some classification, and remedy any laxity in discipline.

DEJEUNÉR AT THE ZOOLOGICAL GARDENS.

After the sectional business had concluded, a magnificent entertainment was given to the members of the British Association, by the President and Members of the Zoological Society. An extensive encampment was formed on the grounds between the great conservatory and the ostrich house, and under the tents there were laid covers for five hundred, superintended by Mr. Mitchell, of Grafton-street. Long before the hour fixed for dinner, the illustrious strangers, as well as the members, crowded the gardens, inspecting the various animals and admiring the style in which this delightful retreat is kept. Shortly after half-past three his Excellency the Lord Lieutenant, accompanied by three aides-de-camp, arrived, when the splendid band of the 7th Dragoon Guards played "God save the King." His Excellency was conducted to his seat at the dinner table by the President of the Zoological Society, Captain Portlock, R. E., the Surgeon-General, W. Tighe Hamilton, Esq., Secretary to the Society, and the Committee of Reception. The firing of a piece of ordnance announced the period for sitting down to dinner. The President of the Zoological Society took the chair. On his left were the Lord Lieutenant, the Duke of Leinster, late President of the Society, Thomas Moore, Esq., Sir J. Franklin, Professor Daubeny, &c.; on his right sate the President of the British Association, Doctor Lloyd, Sir John Ross, Sir Thomas Brisbane, Mr. Babbage, the Surgeon-General, Professor Alison, Dr. Graham, Major-General Sir E. Blakeney, Mr. Greenough, Mr. Murchison, Professor Sedgwick, &c. After dinner the President rose and proposed in brief but highly apposite terms—

"The health of the King."

The toast was drunk with three times three.

The President then rose and observed, that although he felt inclined to act as upon other meetings of the British Association, and merely propose the formal toast, yet upon an occasion like the present, when he saw assembled around him some of the greatest living men of Great Britain, indeed of Europe, he could not avoid offering the warmest tribute of his praise to a body constituted as was the British Association. He little conceived it would have fallen to his lot, as President of the Zoological Society, to preside, on such an occasion, in such a company as he had then the honour of addressing. It was an honour which few could expect to realise. The toast he was about to give was coupled with the name of an individual as remarkable for his knowledge as for his kindness of heart and condescension, such condescension as men of superior minds show to those not equally gifted with themselves. He felt proud in proposing

"The British Association, and their learned and truly able President, the Provost of Trinity College."—Three times three.

The Provost returned thanks in very suitable terms, and expressed his opinion of the vast utility

of the Association; its use and importance was fully appreciated on the Continent by all the most distinguished philosophers. After the learned Provost had taken his seat,

The President again rose and said, that he was sure the toast he was about to propose was one which would be cordially responded to by all who were then present. The distinguished individual whose health he had the honour of proposing, was one who had shed a brilliant light over the field of imagination; and although it was not to be expected that the illustrious nobleman to whom he alluded, would now travel into the field of science, still his works of imagination showed what he might have done had his mental exertions been directed to scientific pursuits. He would therefore give without further preface—

"His Excellency the Lord Lieutenant of Ireland."—Three times three.

The Lord Lieutenant rose to express his sincere gratification for the honour done to him. He felt the deepest sense of pleasure that the first meeting of the British Association in Ireland occurred during the first year of his holding the office of Viceroy. He hoped to witness a repetition of the visit, when he should be most happy once again to meet the gentlemen he had then the pleasure of seeing around him.—(applause.)

The President next rose to pay a debt of respect to the late President of the British Association, and proposed his health, which was received with every demonstration of respect by all present.

The President then rose and observed, that if the healths of all the distinguished men around him were to be proposed, all the butts of wine in the country would not suffice; but he deemed it better to allow the company to retire to enjoy the society of the ladies.

The Lord Lieutenant, the Duke of Leinster, and the other distinguished guests here stood up, and retired, to promenade about the gardens. At this time the doors were opened for the general company, and considerable inconvenience was experienced from the crowds anxious to obtain admission. This was not foreseen, or more extensive arrangements would have been completed to render the access more easy. A second door was opened in another part of the gardens, which contributed to allay the great pressure; numbers, however, obtained admission without being enabled to pay. From six to eight thousand of the gentry and the respectable classes of the citizens were present. The Lord Lieutenant and suite remained in the gardens until six o'clock, shortly after which his Excellency retired. The general company continued to arrive until a late hour.

EVENING MEETING IN THE ROTUNDA.

In the evening a numerous company assembled in the Rotunda, but agreeably to previous arrangements the chair was not taken. The attraction of the night was

DOCTOR LARDNER'S LECTURE ON STEAM CARRIAGES.

Doctor Lardner exhibited on the platform a very elegant model of a stationary engine, employed in drawing a train of carriages on a circular railway. The engine was moved by steam supplied from a small boiler at one side of the room.

The learned Doctor commenced by speaking generally of the properties of steam; a solid inch of water, in being converted into the invisible form called steam, (for the vapour which we see is not the steam, but smoke,) raises a weight of 15 pounds 150 feet, or of 150 times 15 pounds one foot; and hence we might retain as a simple formula, easy to be remembered, that a solid inch of water, in evaporation, raises a ton one foot; and it possesses the same power in the re-conversion, so that by this principle we have a double mechanical agency—first, in the conversion of water into steam, and secondly, in the re conversion of steam into water; in the common steam engines both these agencies are employed.—[Here the learned Professor referred to the model of the steam-engine which stood beside him on the platform; and explained the principle upon which it was constructed.] There was a cylinder, into which a plug exactly fitted—the steam being admitted above, drove this plug down, and the steam having thus performed its office, was changed again into cold water, while the application of steam below drove back the plug; to the plug thus driven up and down is attached a rod communicating with a vibrating beam, which sets in motion an arm to which is attached a wheel, the motion of which may be applied to any purpose. This was the principle of the common steam-engine, simply stated, without entering into the mechanical details of the contrivances. The more difficult point was the re-conversion of the steam into water. This was effected by mixing the steam with cold water; for this, therefore, a constant supply of cold water was requisite, which prevented the employment of this principle in the locomotive engines. These engines, therefore, altogether depended upon the first power, that produced by the conversion of water into steam, and the steam, instead of being reconverted into water, was permitted to escape. In the mode of its escape a most important improvement had been effected; and here was another instance of that humiliating truth, that many of the most important discoveries have been accidental. The steam, when suffered to escape at random, proved annoying to those in its immediate neighbourhood; and it was accordingly found convenient to convey it through the chimney. Here, however, it was found to serve a most

important purpose. In passing into the flue, it created a most powerful blast; and the current of air thus drawn up through the flue acted as a bellows—infinitely more powerful than any that could be contrived, and with this additional advantage, that the blast was powerful or weak, as circumstances required. When the steam was strong, the blast was increased in intensity, and the combustion of the fuel more intense. The speed of a locomotive engine depends altogether on the quickness with which steam can be supplied, and the generation of the steam depends altogether on the heat. The enquiry, therefore, as to the speed of locomotive engines is simply an enquiry how the greatest degree of heat can be applied to the generation of steam. Heat acts in two ways; it acts first by radiation, just as the lamps communicate their light; the particles of heat are radiated against the sides of the boiler, and so the water becomes hot; but, besides, the air which is employed in sustaining combustion, escapes at an intense temperature. If this air were, then, allowed to pass away without any diminution of its temperature, it would be a waste of fuel; it is, therefore, contrived by making it run through intricate passages, that it shall not pass away without being reduced to the temperature of the water, and, according to the laws of equilibrium of heat, it could not be reduced below this without cooling the water. Here, then, was a difficulty—so to regulate its escape, that it might just be reduced to the proper temperature—and it was interesting to observe the struggles of invention to attain this object. Two or three expedients had been employed—the first plan he would endeavour to explain - (here he referred to a diagram placed in a conspicuous position upon the wall)—round about the fire place there was a hollow shell filled with water, against the sides of this the heat radiates, and the steam bubbles; being generated, the steam is conveyed into the chamber prepared for its reception—the air, however, employed in combustion is not permitted to escape at once—a round vessel filled with water is placed between the fire and the chimney—through this vessel run a hundred tubes open at both ends—and these are so contrived in their diameters and arrangement that the heated air which rushes through them is reduced, by the time it reaches the chimney, to the temperature of the water; by this all waste of fuel is prevented; and the air having reached the chimney, although in its cooled state it does not retain sufficient tendency to ascend to bear it up with sufficient rapidity, is caught by the blast produced by the admission of the steam, as previously explained, and carried up the chimney with great force. This was the contrivance adopted in locomotive engines; and by this an engine, weighing itself ten tons, and with a train attached of one hundred, two hundred, or even two hundred and forty tons, moves along a rail-road at the rate of thirty miles an hour. Of the violence of the combustion employed, no idea could be formed by those who only knew fire in its culinary and domestic purposes. Of the intensity of the heat some notion might be formed from an instance of which he (Dr. Lardner) had been himself a witness. In an experimental trip from Manchester to Liverpool, new grate bars had been absolutely melted away by the violence of the heat. Dr. Lardner then proceeded to mention several other contrivances, one, in which a number of concentric cylinders were employed, the spaces between being alternately filled up with fire and water; but the object sought in every such contrivance was to expose as large a surface of water as possible to the action of the heat. Having thus given a rapid outline of locomotive engines, he would proceed to explain the principle of rail-roads. The difficulty of employing steam on common roads arises from a principle pervading all inert mechanical agency—every species of power but animal exertion—that it could not vary its energy without loss. There is no mechanical contrivance by which you can obtain superior power when occasion may require; on a common road the resistance is variable. Dr. Lardner then proceeded to make some observations on roads in general, and on what he termed M'Adam's paradox, that a road through a bog was as good as over rock; this was by no means the case, and the newest plan of making roads is to have for them all a paved foundation; the perfection of a road is that it should be perfectly hard, smooth, and level. The first requisite, rail-roads possess almost to perfection—the second is disturbed by the joining of the rails; this is not apparent on the Kingstown railway, where the rails are new, but on the Manchester and Liverpool it is possible to count the number of rails by the jolts of the carriage. To obtain the level is the most difficult part of all—on a level rail-road the power of nine pounds is sufficient to draw a ton; that is, in round numbers, the same as one to two hundred and fifty; this proportion of weight upon a level would be equivalent to the resistance of an acclivity rising one foot in two hundred and fifty—an acclivity of so gentle ascent, as not to be perceptible to the eye, and yet requiring double the power which is necessary on a level road. Engines have been constructed so as to surmount this difficulty; in fact, at one time to put forth double the power which they do at another; but when the rise is one foot in one hundred and twenty-five, it requires treble force to surmount it, and this is beyond the power of the profitable application of locomotive force. If the rise is less than one foot in one hundred, an additional engine is added, that pulls the train up the hill, but if it be greater than this, it is beyond the power of locomotive engines for this ascent. Another and more powerful species of engine must be employed, which remains stationary at the top of the hill, and pulls up the train by a rope. To illustrate how slight were the acclivities that to locomotive engines were formidable hills, Dr. Lardner stated, that to draw a weight of one ton up Sackville-street, where the rise is one foot in five hundred, a force of thirteen pounds instead of nine would be required. Up the lower part of Grafton-street, an additional engine would be requisite; from Anne-street to Stephen's-green, level as it might appear, the ascent is beyond the power of locomotive engines on a rail-road, and should be accomplished by a fixed engine at the head of the ascent; and all the power of steam could not bring any weight up by a railroad laid on Cavendish-row. Another difficulty is, that rail-roads must be straight—they cannot go round corners,

or even make any considerable curve, because, in passing round a curve, with such tremendous velocity, the carriages receive a centrifugal force, and will be very likely to fly off at the convex side of the curve. This was the only blemish in the Kingstown railway, which, of all railways, was the most perfect in its design. There was just at its termination a curve, with the small radius of half a mile; no curve should have a less radius than a mile—at present this blemish was of no consequence, because this curve occurred at the termination of the railway, where the carriages slackened their rate. If ever, however, the railway is carried farther, as he hoped and was confident it would, this curve must be removed. He knew, however, that the distinguished engineer, who had so admirably planned the line, was perfectly aware of the circumstance of the curve, and had only yielded to inevitable necessity in making it, even where at present, from the cause already mentioned, it was not dangerous. It was not from any inferiority in railways that a curve or a hill, which would be of no consequence in a common road, became so serious here; it was a consequence of their perfection, just as a slight gash, that would scarcely injure a less perfect instrument, would utterly destroy a razor. He had trespassed very long—(no, no, and applause,) but he would only detain them by glancing briefly at the great lines of communication which are projected—the most forward is the line between Liverpool and London—a railway is to run from Liverpool to Birmingham, and from Birmingham to meet the Manchester railway at a point about half way to Liverpool—this railway will be two hundred miles long—there is a magnificent viaduct over the valley of the Ouse, a mile and a quarter long—and several tunnels, one under Primrose-hill, close to the Regent's Park, of half a mile, another a mile and a half, with several of shorter lengths. By this railroad, even were no further improvement to be effected in the speed of the engines beyond the ordinary rate of travelling, the journey from London to Liverpool would be effected in ten hours; but, as it is probable that carriages built expressly for the purpose of speed, which has never yet been made the object of attention, could keep up during the whole way the rate of forty, fifty, or even sixty miles, which speed had been attained on the Kingstown railway in experimental trips, the mail might be conveyed from London to Liverpool in three hours and a half. Dr. Lardner then referred to a map on which all the projected railroads were marked—one from London to Southampton, another from London to Bristol. It was impossible to calculate the moral, political, and commercial effects of these railroads. It was found that the making of a railroad trebled the intercourse along the line. The intercourse between London and Liverpool was 1,300 persons a day, as ascertained by stamp returns. The intercourse between London and the three towns he had mentioned was annually a million and a quarter—very nearly the amount of the whole population of London. Other railroads were projected, to York, and Edinburgh, and Lincoln; and last—not least—one that he trusted yet to see—the highway to New York (cheers); he meant the projected line from Dublin to Valentia (renewed cheering.) From this the greatest good must follow; steam packets could ply from Valentia to Halifax in twelve days, and thus the whole intercourse with America be brought within the reach of steam navigation; all passengers from the western world would then pass through Ireland, and he (Dr. Lardner) knew of no project more calculated to tranquillize and enrich Ireland than the construction of the proposed railway, in the line of which there is no insuperable obstacle (great cheering.) Our transatlantic brethren had done much in constructing railroads, which were not inferior to ours, as had been erroneously stated—46 were completed, and 137 either contemplated or in progress; one was now projecting from Baltimore to the vale of the Ohio, which would be 330 miles in length. The learned Professor concluded his interesting Lecture amid the plaudits of the highly respectable assembly which filled the room.

The meeting adjourned to the supper rooms about half past ten o'clock, where ices, tea, coffee, fruit, &c. were served in abundance.

MEETINGS OF THE ASSOCIATION, WEDNESDAY, AUG. 12.

BREAKFAST AT THE COLLEGE OF SURGEONS.

At nine o'clock this morning, this learned Society entertained the distinguished strangers, and a great body of visitors, at their splendid College in Stephen's-green. The Library, Examination-Hall, and Museum, were thrown open as reception-rooms, and the *dejeuné*, on a scale of princely magnificence, was laid out in the Board-room, Committee-rooms, and other apartments, in this chaste and magnificent building. The highly respected President, ALEXANDER REID, Esq. presided. The Fellows and Licentiates of the College acted as a reception committee, and seemed to wish for no greater gratification than attending to the comfort and convenience of their visitors. Nearly six

hundred persons were present—and notwithstanding so vast a body, the entertainment had all the quietude and comfort of one given in a private house, and to an ordinary party.

After breakfast all the rooms in the College were thrown open for inspection, and every pains taken by the Curator of the Museum, and several of the Members, to explain and point out the most interesting subjects to the various visitors.

The wax figures, munificently presented by the Duke of Northumberland, were an especial object of admiration. A finely executed bust, by Kirk, of his Grace, has been placed in the Museum, at the expense of the College, in testimony of the respect due to him. The collections of *Cancri* and Madrepores were also greatly admired. The entire collection is worthy of a body holding so distinguished a place among the learned societies of Europe as the Royal College of Surgeons.

About eleven o'clock the members repaired to the various Sections, the meeting of Section E. being held in the Anatomical Theatre of the College.

SECTION A.—MATHEMATICS AND PHYSICS.

The first paper read was the continuation of Mr. Snow Harris's observations on the use of the Proof Plane and Torsion Balance, as used by Coulomb, in his electrical experiments.

Mr. Harris began by giving a sketch of the theory of electricity most generally admitted at present, commonly known as the French theory. According to this, two fluids pervade all parts of the material creation; when these fluids are united in a certain proportion, they neutralize and disguise each other; and this is the state of the electricities of bodies which we denominate their "natural state;" but when these fluids are separated from each other, the body upon which either of them is accumulated is said to be electrified, and one of these fluids is called the "positive," or "vitreous kind," the other the "negative," or "resinous kind." Each of these possesses properties by which their presence in a separate state is readily detected, and by which they may be easily distinguished. The simplest form of the law according to which their actions, it is said, may be estimated, is this: "Bodies electrified with the same kind of electricities, repel each other with a force proportional to the inverse square of their distance. Bodies electrified with opposite kinds, attract each other with a force proportional to the inverse square of the distance." To the mathematical part of this law Mr. Harris strongly objected; for although some experiments (and these he exhibited to the Section,) accorded with the law, yet others were entirely opposed to it. These experiments were of a very simple kind. By his unit measure he ascertained the quantity of electrical charge given to the one body to be exactly the same in the several experiments, and then by a nicely-poised balance, the other body being made to take the place of one scale pan, he determined the amount of the attraction exercised under various circumstances of distance, size, insulation, &c. He showed that the law of the inverse square of the distance only held true when the attracted body was not insulated; but when insulated, the law depended on the quantity as well as the distance; and, *cæteris paribus*, did not follow the inverse square of the distance, but the inverse distance itself; this Mr. Harris attributed to the reflex action of the electricity accumulated by induction; an element in the entire effect, which he stated had been most strangely overlooked by the mathematical theorists. He stated, that the results of his experiments on this point were as follows: when a smaller surface is opposed to a greater, (the amount of attraction under given circumstances of distance and insulation being determined, and reduced by his method to some denomination of weight,) and that the smaller surface then increased, all other circumstances remaining unchanged, the amount of the attraction would increase and attain its maximum when the two surfaces became equal; but if after that the magnitude of the attracted surface be augmented to any extent, the amount of attraction would not increase farther. From this fact he concluded, that the electrical influence did not, as the mathematical theory supposed, radiate in all directions from a centre, but that it only manifested itself in lines parallel to the line which joined the two nearest points of the attracting surfaces. In conformity with this view, he stated, that the attractive influence of two opposed spheres would be precisely the same as the influence of the two nearest he-

mispheres, and that if the two nearest points of the hemispheres be joined by a straight line, points in this joining line could be assigned, in which, as it were, the entire effect might be considered as residing, or which might be viewed as the centres of attraction; and accordingly, if at the distances of these points, two planes having the same superficial extents as the hemispheres, were placed, the attractive force exerted by these planes would be precisely the same as the attraction of the two spheres, or of the two hemispheres, as he had frequently proved. Mr. Harris next adverted to the commonly received opinions respecting the detention of electrical charges upon the surfaces of bodies, and the distribution of it upon surfaces of various shapes. As to its detention, the ordinary opinion is, that, but for the air which surrounds the body, it would be impossible to confine an electrical charge upon its surface, the electrical particles themselves being highly repulsive, and not being attracted by the particles of matter on the surface of the body. He gave various cogent reasons which compelled him to dissent from this opinion; and, in particular, he stated, that he had succeeded in retaining the electrical charge for some days, upon a brass ball inclosed in a vacuum, the vacuum being so perfect that the air-pump guage showed the exhaustion to be 299 parts in 300. An electrometer connected with this ball, showed an almost unimpaired degree of divergence for more than 24 hours.

An eminent practical philosopher in London had deemed this experiment of such importance, that he had repeated it with every possible precaution, and had since communicated to Mr. Harris his conviction of its correctness. As to the law of distribution of electrical atmospheres upon spheres, spheroids, and other shaped bodies, as investigated by Coulomb, Mr. Harris dissented from it. The results, he stated, depended entirely upon the accuracy of the proof plane as a means of determining the relative quantities of electricity on the various parts of the surface of the electrified bodies. This accuracy, he asserted, was entirely disproved by the experiments which he had previously shown to the Section, for it appeared, that it was only the power possessed by the several parts of the surface of an electrified body to decompose the natural electricities of the proof plane, that it tested; and this power might be consistent with an equal distribution over the surface, or, indeed, with any law of distribution whatever. The proof plane, therefore, could not afford any test of the true law of distribution, it being obvious, that the decomposing effect depended upon the quantity of surface that in each case became opposed, as well as upon the nearness or remoteness of the several elements of the opposing surfaces, circumstances which would obviously vary much at the several parts of the surfaces of variously shaped bodies. In one notorious instance, he conceived the use of the proof plane had entirely misled philosophers: from it, they had concluded that the internal surface of a hollow body is entirely devoid of electricity, because a proof plane, when introduced into a hollow electrified sphere, came out without any signs of electrical charge. The following experiment disproved the accuracy of the conclusion. If you fill a glass globe, furnished with a neck, half full of warm mercury, and, setting it in mercury, charge it as you would a Leyden jar; upon pouring out the quicksilver from the inside, every one knew that the glass remained strongly charged; yet, the proof plane, being introduced into it, manifests no sign of electrical charge whatever when withdrawn. Here then, where we know electricity to exist *within* a hollow body, the proof plane fails to manifest it; and therefore its indication, in the case of hollow charged metallic bodies, does not warrant the conclusion that the electrical charge does not extend itself to the internal surface. Mr. Harris's quantitative experiments led him on this subject to the conclusions,—that free electricity was equally distributed over every part of the surface of conducting bodies; that when the quantity of electricity imparted was given, the tension was greatest on a circular-shaped body, and least on a plane surface extended like a line; and that equal quantities give equal results with the balance, when distributed upon equal surfaces, whatever be their shapes. In conclusion, Mr. Harris begged to state to the Section a fact which had greatly surprised himself. In charging the large Leyden jar with the unit measure, the quantity which it as it were threw in at the transit of each spark, was precisely the same at the beginning of the process of charging, in the middle, and at the end; and was not, as would at first be imagined, a continually decreasing quantity, as the

charge advanced to its completion. This he proved by a very simple experiment, depending for its explanation on the fact, that while a jar charges, as much electricity must pass from the outer coating, as goes to the inner surface; the jar to be charged being therefore insulated, and a knobbed electrometer attached to the outer coating, the passage of a spark became an index of the quantity of charge received, and it was found that the number of sparks given by the unit measure, to produce one discharge from the outer coating, was the same at all the several parts of the process of charging.

Mr. Whewell,—after warmly eulogizing the indefatigable industry and the experimental skill of Mr. Harris, and praising the simplicity and accuracy of the instruments invented by him, and employed so successfully in the investigation of these very interesting phenomena,—trusted that Mr. Harris would not be too easily induced to conclude, that his valuable experimental results were at variance with the received theory. For his part, he felt satisfied, that if the time of the Section would permit, he could show that there was a complete accordance between the experiments and the theory, as far as the variety and complexity of the results placed before the Section permitted him to attempt tracing the agreement; but he acknowledged that the theory must be put to the test, whether or not it could accurately explain each and all of the interesting experiments of Mr. Harris; and he admitted, that if it was found insufficient to account for any of these experimental facts, it must at once yield, and be either rejected, or modified to suit the advance of knowledge, which he had no doubt these experiments must on either supposition effect. In one only instance would he delay the Section, by pointing out the caution with which we should admit these experiments to be adverse to the theory. Newton had shown, that if a body be placed within a hollow sphere, the parts of which attract it with forces reciprocally proportional to the square of the distance, the body would then be between opposite and equal attractions, soliciting it every way, and would therefore be in effect uninfluenced in any direction. On this principle, the proof plane immersed in the charged glass globe should be uninfluenced by any of the equal and opposite attractions, and should therefore come out as it does, without any signs of electricity.

Mr. Harris observed, that if the theory could explain the fact, that the proof plane was not affected by the hollow glass globe, which was known to be electrified, why could it not equally explain its not being affected by the hollow brass globe, without deducing from the fact, that there was no electricity upon the internal surface?

Captain Sabine then read an abstract of his report upon the researches of Hansteen on the 'Distribution of Terrestrial Magnetism.' He first gave a succinct account of the state in which this illustrious philosopher had found this important branch of practical science, and the light that his researches had shed upon the subject. Halley, from a careful comparison of all the observations on the magnetic variation and dip, which he could in his day obtain, had concluded that they were inconsistent with the supposition of the earth having only one magnetic axis, and two magnetic poles. To account with any degree of correctness for ascertained facts, it was necessary to suppose, that two magnetic poles existed in the northern hemisphere of the earth, and similarly, that two other poles existed in the southern hemisphere. Captain Sabine illustrated, by diagrams, the character and positions of the curves of no variation, in the year 1600, and pointed out the diversity of their form in the northern and in the southern hemispheres; he stated, that a comparison of the position of these curves, with the vast mass of observations collected and arranged by the indefatigable industry and skill of Hansteen, proves them to have an easterly motion in the northern hemisphere, and a westerly motion in the southern. In conformity with the fact, that the magnetic axis of the earth was not single, is another important fact—viz. that the line of no dip (or series of places where a well-balanced magnetic needle would lie horizontally,) is not a great terrestrial circle, but differs most materially from such a circle. Neither is the intensity of the magnetic force by any means equal in similar positions in the two hemispheres; nor is the intensity found to be the same in places where the dip of the needle is the same. The researches of Hansteen on this subject,—which is of the utmost importance, nay, almost of vital interest to maritime countries,—attracted so much at-

tention, that the government of Russia engaged him to proceed to Siberia, and there accumulate a sufficient number of accurate observations, upon the variation, dip, and magnetic intensity. He returned about two years since, and has fully established the fact, that a second north magnetic pole exists in that neighbourhood. It fortunately happened, that Captain Parry was engaged during the same period, in his researches in the parts of the earth which lie near the other north magnetic pole; and thus a mass of facts has been accumulated, amply sufficient for the examination of the question as regarded these two poles; but it is very desirable, that similar simultaneous observations should be made in the neighbourhood of the two poles in the southern hemisphere, which, in the time of Halley, occupied, one a position in Van Diemen's Land, the other in or near Terra del Fuego. Captain Sabine concluded his interesting and lucid abstract, by expressing a hope that the Association would endeavour to interest the government in this important undertaking, and the Committee has, in consequence, agreed to petition government on the subject.

Professor WHEATSTONE detailed the results obtained by him when attempting to form by the prism a spectrum or coloured image of the spark obtained from an electro-magnetic apparatus, as also of the sparks produced under various circumstances from simple galvanic influence, and from an electrical machine. In the spectrum or coloured image formed by a beam of solar light when analysed by a prism, the colours succeed each other without any interruption, except that when the prism is of very good glass, certain dark bars cross the image at fixed though unequal distances. Mr. Wheatstone examined the light produced by a revolving electro-magnet, expecting to find something of a similar effect, but to his surprise he found that the simple coloured lights that presented themselves were separated by great intervals, in which no light whatever could be seen,—and this with such regularity as to afford a test, not only of the substance through the instrumentality of which the light was procured, but also a test of the strict identity of the light produced by galvanism and by electro-magnetism, and to prove that the light of common electricity was essentially distinct from either. When mercury was used as the means of producing the spark, Professor Wheatstone found the series of colours and their distances from each other to be readily distinguished from the series and distances of the colours resulting from the spark produced when any other metal was used; and the same circumstances for each of the other metals which he was able to use in the fluid state were so characteristic as to afford means of distinguishing them. He also found that the light produced by the combustion of each of these metals was so dissimilar from that produced from the electro-magnetic, galvanic or electric spark, that Professor Wheatstone came to the important conclusion, that these sparks cannot result from the combustion of the metals, but rather from a portion of the metallic conductor carried off by the electric discharge and ignited. This communication created much interest, and Professor Wheatstone was kind enough to promise on a future occasion to exhibit these curious appearances to any members of the Association who might feel an interest in the subject; this he accordingly did on two succeeding occasions, when we had the pleasure of seeing this curious phenomenon, and had an opportunity of observing how very accurately the Professor had detailed the appearances.

Mr. FOX exhibited to the Section an instrument for observing the magnetic dip, variation, and intensity. It consisted of a very light needle mounted on jewelled centres, placed in a brass box which was capable of turning in azimuth, an azimuth circle being placed beneath; on the back of the instrument was a vertical circle, with a tube like a telescope mounted on its centre; at the top of the tube was a small achromatic lens, near the principal focus of which within the tube was placed a piece of plane glass with a small black spot in its centre. When the tube was directed to the sun, this black spot caused a very sharp annular mark to be depicted on a white screen placed a little beyond the tube in the axis of the lens; by observing this annulus with a magnifying glass, Mr. Fox stated that he could observe the most minute motion of the sun; and the instrument in this way became an instrument well fitted to observe equal altitudes of the sun or of a star, and thus the plane of the meridian of the place could be ob-

served. The instrument being then moved into the plane of the magnetic meridian, the variation is to be read off on the azimuth circle; the dip is then had on the inner vertical circle, and, to ensure greater accuracy, is to be observed with the face of the instrument first placed east, then west. To ascertain the magnetic intensity, two standard magnets inclosed in brass cylinders are placed in sockets fitted for their reception in the back of the circle, at opposite sides from the centre. The alteration of the dip caused by these magnets gave, by a simple formula, a means of estimating the variation of magnetic intensity. He had tried many thousand experiments with the instrument, and had submitted it to the examination of Sir John Franklin, who had on several occasions observed with it, and the results had been most satisfactory and accordant.

Professor STEVELLY inquired whether there was any provision for retaining the standard magnets of the instrument of a uniform intensity?

Mr. FOX answered, no; but any alteration was easily detected by observing the intensity at a given place.

Doctor ROBINSON thought that by a number of observations it might be possible to get equations from which any change in the intensity of the standard magnets might be eliminated.

Professor STEVELLY replied, that even if this were possible, which he doubted, it would introduce too much complexity into observations with the instrument. And as every person conversant with magnets must be aware how subject they were to change their intensities, he thought this an objection fatal to that portion of the performance of the instrument. This, however, was of less importance, as Professor Lloyd had made public a simple and efficacious method of observing magnetic intensity with the common dipping needle, by simply causing a deflection with small bars acting by their weight.

Sir JOHN FRANKLIN bore strong testimony to the accuracy of the instrument in observing the dip and variation. He stated that, in the first construction of the instrument, the needle had been made too heavy, and the centres had not been made to work with sufficient freedom; that he had pointed out these defects to Mr. Fox, who had with much perseverance remedied them; that he had since made frequent trials of the instrument, and compared its indications with others which he depended implicitly upon, and had found them to agree in a very remarkable degree.

The Rev. Mr. M'GAULEY explained his electro-magnetic machine for producing motion, and stated the prospect which was being opened of converting the power of electro magnets to useful purposes. He also detailed a number of experiments to illustrate the nature of electro-magnetic induction.—The first part of Mr. M'Gauley's paper having occupied the section a considerable time, the remainder was deferred until Thursday. The novelty and ingenuity of the Rev. Gentleman's views, excited much attention. The paper was entitled "an enquiry into the possibility and advantage of the application of magnetism as a moving power; with remarks on the nature of magnetism"—a full report of which will be found in the proceedings of Thursday.

Professor HAMILTON then communicated his views respecting the science of Algebra, and in particular respecting certain quantities of a high order, the uses of which he wished briefly to advert to. The Professor began by observing that it had long been a question in what category algebra was to be placed—was it a science, an art, or merely a language? In his opinion, as it was ordinarily taught, and made the subject of investigation, it could scarcely demand any higher rank than that of a very compendious and precise language; yet he had no doubt that it might be so treated as to rank as one of our most abstract and yet practical sciences. Geometry, he conceived, might be simply viewed as the science of pure space: and algebra might be so treated as to be the science of pure time or duration. The quantities of which geometry treated were all easily conceived and readily comprehended, but many of the symbols at present used in algebra had no conceivable value or antitype existing. The conceptions of negative quantities which met us in our very first entrance upon algebra, were with great difficulty attained by ordinary learners; and the doctrine of imaginary or impossible quantities had to many persons assumed the appearance of downright inconsistencies and absurdities. These, no doubt, might be reduced to a strictly comprehensible

form by the theory lately advanced by Mr. Graves, and respecting which he had had the honour of submitting some additional views to the Association and to the public; but, as he conceived, it yet remained to reduce the entire to one consistent system, and this he thought could be done by maintaining a constant and strict reference to the times during which quantities of any kind may be considered as increasing or diminishing, as had already been done to some extent in some of the higher branches of algebra. He showed how, on this principle, the ordinary processes of addition, subtraction, multiplication and division, could be reduced to one common mode of conception, and how all the ordinary algebraic symbols of plus and minus, &c. would become parts of one harmonious system, whilst they expressed simply the increments and decrements of quantities. But he conceived that these very symbols and the same notation would thus become applicable to quantities of a much higher order than any that ordinary algebra presents to us: for instance, quantities increase or they diminish; and these increments and decrements may be viewed as in common algebra, as simple quantities, with positive or negative signs attached to them, or the ratios of these increments or decrements to one another, in relation to the time in which they took place, might be investigated. In this point of view it was obvious that,—besides the marks of quantity, and positive or negative signs which would belong to them as simple quantities,—their ratios would then require to be expressed, first, as quantities, and then they would, when they increased the quantities to which they belonged, admit or require the positive sign; but, when their effect was to diminish, they would admit or require the negative sign. But farther they might increase at an increasing, or they might diminish at an increasing or diminish at a diminishing rate; this again would introduce a new distinction of sign, and so on; and thus quantities of a higher order than any as yet admitted into common algebra might be introduced, and treated in a manner harmonizing with the entire system. These higher orders of numbers or quantities he would propose by an obvious adaptation of two Greek words to call Logologue, did he not fear that the oddity of the term might seem to cast an air of ridicule around what he conceived to be of very important and very general utility in the science. The learned Professor intimated his intention of reducing these rough views, which he had now laid before the Section, to a more systematic form, and giving them to the public when he could command sufficient leisure.

The section was then informed by the President, that he must form a Sub-Section, the business already being too great for the time of the Section itself; and that in the morning, the business to be brought before the Sub-Section would be posted in the Examination Hall. The place fixed for its meeting was the Law School of the University.

SECTION B.—CHEMISTRY AND MINERALOGY.

The Section was occupied with a paper, illustrated by coloured drawings, by Mr. R. Mallet, of Dublin, on certain very singular alterations in form in the flame from large coal gas Argand burners, by the introduction of a forcible stream of air, of a determinate magnitude, within the flame, the apertures of the burner being extremely minute, and closer than ordinary. He showed that the flame is reversed in direction entirely, and passes parallel to the stream of air, but in the opposite direction. In some conditions the flame becomes a spiral. He also described some singular acoustic phenomena connected with flame thus situated, which produces similar musical notes with pure hydrogen burned within a tube. The flame gives little light, and is a deep blue. The phenomena appear paradoxical, and have not as yet been accounted for. He was unable to repeat the experiments before the Section from want of a supply of coal gas in the laboratory.

The reading of this paper gave rise to several observations on oil and coal gases, and on flame.

Dr. Dalton mentioned, that when equal volumes of coal gas are burned, one volume being first mixed with half its volume of atmospheric air, that though the mixed gas gives little or no light, yet the quantity

of heat given out by it, is equal to that afforded by the unmixed gas.

Mr. John J. Hawkins described a very interesting experiment he had made on the mutual effects of flames from an oil lamp, and the consumption of oil, in relation to the size and number of flames. Having provided a tin lamp, with four small cylindrical wicks, arranged in the angles of a square, and distant, on the side of the square, by an interval equal to the diameter of the flame from any one of them, he lighted one wick, and observed the height of the flame; he then lighted that next to it, and found the two flames united, and formed a single one of twice the altitude and twice the breadth of the first; the third was lighted, and united flame rose three times as high as the first one; and so of the fourth, the flame of which had four times the linear dimensions of that from the first wick. Under those conditions, therefore, the altitudes of the flames are as the numbers 1, 2, 3, 4, and their magnitudes or masses as the squares of the same, or as the numbers 1, 4, 9, 16. He also stated that he had found the consumption of oil to follow the same law, that is to say, to be in the ratio of the bulks of the flames.

He further mentioned an interesting fact, which he had observed, which was corroborated by Dr. Dalton, Dr. Thompson, and Mr. Connell; namely, that in a lamp, with several wicks arranged in a right line, the intensity of light, at a given distance from the lamp, was equal in the direction of the line of wicks, or perpendicular to the same; that is, that the amount of light radiated in either direction was independent of the surface of flame from which it was emitted.

Mr. Connell read a paper on fossil scales, and from an analysis of them suggested the means of discovering whether they were those of fishes or reptiles. The scales of fish he found afforded much phosphate of lime, while those of reptiles afforded a very small quantity.

Dr. Kane read a memoir on some compounds of the chlorides of platina and of tin. He stated that he was led to these researches by an accidental observation of the splendid red colour produced by the union of these bodies. Protochloride of platina unites with protochloride of tin in two proportions. That containing least tin, is dark olive brown, decomposed by much water into muriatic acid and oxides of tin and platina. The second body containing most tin, is of a magnificent red colour, decomposed, by much water, into muriatic acid and a fine chocolate powder. By the action of ammonia there is obtained a black substance, containing tin and platina in proto-combination, which, when heated, burns brilliantly, with some detonation, and gives metallic platina and peroxide of tin.

Professor Kane then showed, by transmitting the light of a lamp through the red substance in solution, and analysing the beam issuing by means of a prism, that the red colour was quite homogeneous—that it was the red of the rainbow. He suggested that this property may render that substance of use in certain optical experiments.

Mr. Snow Harris exhibited a newly-invented electroscope, of extremely sensible and accurate construction, and demonstrated to the Section the fact, denied by Pouillet, that electricity is developed by the evaporation of pure water. The electroscope is affected at twenty feet distance from the plate machine. It consists of an insulated gold leaf, placed between two gilt balls, within a glass globe, to defend it from atmospheric disturbances, and direct electrical influence. The two gilt balls are connected with the opposite poles of a dry voltaic pile, consisting of three hundred pair of small zinc and silver plates; the gold leaf, therefore, remains, when not under electric excitement, freely suspended between the balls; but if a body, negatively excited, approaches the wire from which the gold leaf is suspended, it instantly touches the opposite pole, and if the excited body be positive, the contrary effects follow of course. The gold leaf was strongly affected at a distance of several feet by a glass rod slightly rubbed with a silk handkerchief. When a small platina crucible, heated red hot, was placed in electrical contact with the gold leaf, and some pure water dropped into it, the electrometer was instantly and powerfully affected. Owing to the difficulty of showing the experiment distinctly in a crowded room, he performed it the following day in the laboratory attached to the place of meeting, in the presence of Mr. Whewell, Professor Moll, the Vice-Presidents, and several other persons.

Mr. Narbiggings made a communication on the effects of the colour green, painted upon a china bowl, upon the venous blood.

A communication was made by Mr. Hartop rela-

tive to the use of hot air in iron blast furnaces in Yorkshire, in which he stated that this mode of supplying the smelting furnaces possessed but few advantages, and also deteriorated the iron, which had consequently fallen much in value. This gave rise to a conversation, in which several gentlemen stated that the price had not been so diminished in other parts of the country.

SECTION C.—GEOLOGY AND GEOGRAPHY.

A Paper was read by Lieutenant STOTHERD on a small isolated patch of granite which occurs in the county of Cavan. Its superficial extent is about seven square miles, and it is separated from the nearest group of primitive rocks, that of the Mourne mountains, by the greywache or transition schists. This small district is entirely surrounded by transition and secondary rocks, and exhibits all those changes in the structure of the sedimentary rocks which are usually observed on their approach to or contact with rocks of a decidedly igneous origin, the schists becoming indurated and often changed to quartz rock. The appearance of primary rocks so far removed from any of the greater masses, is extremely important in geological speculation, and assists in this instance in explaining the broken and detached character of the schistose hills, and the induration of many of their strata, since it is probable that the granite is at no great distance from the surface in the whole space between the Cavan primary rocks and the Mourne mountains, of which they may be considered an extension.

Mr GRIFFITH resumed his observations on the rocks of Ireland, referring frequently to his map and the illustrative sections which accompanied it. Having previously described the sedimentary, he now entered on the crystalline rocks considered as rocks of intrusion. In the Wicklow range, extending to Brandon, the granite contains no hornblende, and, as previously noticed by Mr. Weaver, occurs sometimes as beds in mica slate. In the Mourne or Down range, the granite contains hornblende, which frequently predominates over the mica. In Wicklow, mica slate, passing into gneiss and clay slate, abut without disturbance against the granite. In Down mica slate is wanting, and the other schistose rocks are frequently disturbed. In western Donegal mica slate and quartz rock are abundant, the quartz rock being developed to a great extent; and in Galway also, associated with mica slate, quartz rock is extensively diffused. In both these counties granite occurs, and the crystalline stratified rocks are referred to as affording distinctive characteristics of its several localities. The phenomena usually exhibited by granite veins are frequently observable, such as their passage through the adjacent schists, detached portions of which are often enveloped in their substance, and the change they effect in their structure. Mr. Griffith now described the older and newer trap districts, mentioning many interesting particulars connected with them, such as the capping of quartz rock by greenstone, the concentric arrangement of the beds of greenstone in Donegal, and the occurrence of quartz rock between two beds of greenstone, the quartz being columnar, the trap above and below it, not. In Slieve Gullin greenstone and granite were stated to be actually mixed together, whilst in Carlingford the contact of the sienite (or greenstone) with the granite, is concealed by debris. After noticing briefly the ochre beds which so often separate the beds of basalt, and expressing his belief that the trachytic porphyry of Sandy Brae in Antrim, was nothing more than this ochre indurated by heat, Mr. Griffith adduced the fact of beds of sienite, traversing the cliffs of Murloch bay, and containing detached portions of chalk, as proof that the sienite was posterior in appearance to the chalk, and gave as his opinion that all the crystalline rocks had been fused, and in most cases projected from beneath through the sedimentary rocks, the appearance of regular strata being due to their projection in a direction parallel to the strike of the beds.

Professor SEDGWICK considered the crystalline rocks of Ireland, as described by Mr. Griffith, to accord with those of similar districts in England and on the Continent, and adduced examples of beds of greenstone occurring in schists in Merionethshire and Caernarvonshire. He pointed out also the natural cause of uniformity in crystalline rocks which is to be found in the small number of elements of which they are composed

Mr. MURCHISON, though agreeing with the general views of crystalline rocks, considered that there were many examples of those rocks inter-

stratified with slates which exhibited no appearance of intrusion, a position to which Mr Griffith assented.

Mr. GREENOUGH was not convinced by the example cited, that sienitic granite had been protruded subsequent to the chalk; and Captain Portlock suggested that the term might have been applied somewhat vaguely.

Professor PHILLIPS in commencing his observations on the numerous group of extinct fossils called belemnites, enforced the necessity of having right impressions on general points, and of showing the exceptions to, as well as the general uniformity of, any given rule. For instance, the laws of distribution in crustacea may be very different from those of belemnites, which only proves that no single rule can be applied to all families. Of belemnites one hundred species have been described by foreign writers, and Professor Phillips has extended the number of British species to thirty-four, (eighteen only of which were described by Miller.) This family of organic remains, is of the highest interest in Geology on account of its relations to most cuttle-fish tribes, and the remarkable laws of its distribution in the earth. While the orthoceras belongs to the primary and carboniferous series, the trerrilites to the chalk series, and the nautilus to every part of the system of strata; belemnites belong exclusively to the orbitic and chalk rocks; and the several groups of which the family consists, make definite parts of those systems. The whole group appears to have been of delicate organization so as not to be able to resist the changes of conditions which have visited the ancient oceans of our planet. And this susceptibility constitutes one of the principal sources of their value as Geological indices.

Professor PHILLIPS urged in eloquent terms the great advantages of applying philosophical zoology to a minute examination of fossil remains, and stated, that it was only by the study and comparison of recent bodies, that those doubts and difficulties which attend the investigation of organic remains can be removed. Not merely did he expect to separate series of strata, but hereafter by organic remains, to determine the boundary of ancient oceans.

Professor AGASSIZ, the distinguished Fossil Ichthyologist, confirmed Mr. Phillips's observations on the advantage of comparing organic remains with living animals, in order to determine the conditions which have occasioned the disappearance of certain bodies at certain epochs. To the history of the Belemnites, he added the interesting fact, that he had observed a part like the bone of the cuttle-fish at the end of the belemnite, and that he considered the parts of the belemnite to exist in a rudimentary state in the cuttle, thus perfecting our knowledge of this animal by connecting it with the sepia.

Mr. MURCHISON and Professor SEDGWICK, made some valuable observations on the bearing of these discussions upon the general progress of geology.

Mr. GRIFFITH stated the existence of an extensive marle deposit in Wexford, some of the shells of which Professor Phillips considered to correspond with those of the crag.

Captain DENHAM, R.N. brought forward the results of his examination of the tides in the Port of Liverpool, exhibited in very comprehensive and laborious tables. He also detailed many facts of great interest, such as the discovery of a new channel, perpendicular to the course of the tide way, which channel had passed unnoticed, though it had probably long existed, and was a consequence, he supposed, of vertical pressure. The great extension of the sand in several places was dwelt upon as adding to the value of this channel, so unexpectedly formed by nature. Captain Denham then stated, as another result of his researches, that whilst the high and low water-mark varied according to the positions of the sun and moon, the half-tide mark remained constant; and expressed his hope, that marks in various places would be set up to enable a comparison to be made between this constant point and the varying levels of sea and land, by which the amount of change in the latter might be correctly estimated.

Professor SEDGWICK and Mr. MURCHISON warmly applauded the zeal and intelligence exhibited by Captain Denham in these researches, equally valuable to the navigator and to the geologist, and moved the thanks of the Section to Captain Denham, for having so ably carried them forward, and to Sir John Tobin, for the liberality with which he had promoted and supported them. This motion was carried by acclamation.

SECTION D.—ZOOLOGY AND BOTANY.

Mr. NICHOL read a paper on the structure of the horizontal branches of the natural family of Coniferæ. This is highly interesting and useful in observing fossel remains of vegetable substances.

Dr. NEILL made a communication on the seeming hybernation of a land-rail; it was found in Orkney, when brought near the heat of a fire it was restored, but died shortly afterwards.

A communication of a highly interesting character was made by Professor DAUBENY on the circumstances affecting the exhalation of moisture from the leaves of plants—the influence of light and heat together, and heat without light. A very interesting discussion arose out of the subject.

Dr. JAMES DRUMMOND MARSHALL made some observations on the Natural History of the Island of Rathlin, off the northern coast of the County of Antrim. He mentioned, that the only *quadrupeds* found on the island are the hare, the Norway rat, common mouse and shrew mouse. Of *birds*, there were observed thirty-one species of land birds, and twenty-six of water birds; the latter were very abundant, particularly the larus ripa, larus argentatus, alca torda, uria troile, and uria grylle, and their breeding haunts were situated on almost every headland round the island. The *fishes* frequenting Rathlin are, for the most part, similar to those found round the north-eastern coast of the County of Antrim; among them were mentioned the coal fish, launce, lythe, wrasse, ballan wrape, and grey gurnard.

Professor ALLMAN submitted a plan for the arrangement of plants according to their natural affinities. (For copy of Plan see Appendix.)

SECTION E.—ANATOMY AND MEDICINE.

This Section assembled in the Anatomical Theatre of the College; this was a new feature in the proceedings, as, hitherto, as well as subsequently, this Section met in the Royal Irish Academy.

Dr. PRICHARD, Dr. COLLES, and Mr. CRAMPTON, alternately presided.

The first paper read was by Mr. M'DONNELL, of Belfast, on the pulse and state of breathing in the fœtus, and in early infantile life.

Dr. M'Donnell referred briefly to a former paper, of which the one he was about to read might be considered the appendix. The former had been laid before the Medical Section of the British Association, at Edinburgh. He began by describing what he called the *differential pulse*, and gave proofs of his claim to priority in such observations, having commenced as early as 1784. He dwelt at considerable length on the importance of paying strict attention to the posture, in all cases where the pulse is concerned, as it was a well ascertained fact, that the number of pulsations in a given time, varied with the posture of the individual on whom the observation was made. In lying, sitting, or standing there are three distinct numbers in the pulse, any one of which being given, the rest may be discovered by inference. This variation amounts generally to twelve, fourteen, or sixteen beats per minute, as its normal state, and, therefore, all observations of the number of the pulse, which have been made without reference to this principle, must be considered as nugatory, unless it be implied that the person was in the *horizontal position* when the observation was made. This rule for reducing the number of the pulse to a regular standard applies to health, but not precisely to disease; the effects of posture must be investigated separately in each disease.

The *differential pulse* appears to be confined to man. It is not observed in brutes, probably because, from their form, their posture may be considered as always horizontal; but when placed erect, this peculiarity appears also in them.

The variation, in the human species, is at its maximum in tall and feeble subjects, particularly in convalescents from typhus; the minimum is generally found in children. These facts lead to the supposition, that this phenomenon is connected with some hydrostatic law, and not depending entirely on vitality. This, however, is merely thrown out as a conjecture, and requires further investigation. But in whatever manner it may be considered, it is plain that in all attempts to ascertain the effects of remedies, as well as of natural causes, due allowance must be made for these fixed differences produced by posture. What avails it to say that a medicine, or venesection, or heat, or cold, or a thousand other natural causes, raise or depress the pulse by four, six, or eight beats per minute, when the mere change of posture would raise or depress it twelve, fourteen, or sixteen per minute, and this merely in health, for in

disease the differential pulse is often double this proportion.

In tracing the connexion between the pulse and respiration in man and quadrupeds, he finds that it ranges in health from four to six pulses for one respiration. This he considers a new and material fact; for if it be established by further observation, that this is a general law, we shall be able to infer the pulse from the respiration, and *vice versâ*. This may be of advantage in enabling us to ascertain the number of the pulse in ferocious animals which we dare not touch, as well as in man during action or progression.

There is a coincidence between the number of pulses and steps in walking, at the common rate of progression in man, that is very remarkable, and has not been hitherto noticed. His breathings are also singularly proportioned to his steps, so that it is easy to deduce these numbers from each other. But in hard labour or violent muscular exertion, as in running or ascending heights, the proportions are greatly altered. The same thing occurs in many forms of disease. There is reason to believe, that the carbonization of the respired air, has a great influence in all those cases where the number of respirations is greatly disturbed.

One thing invariably occurred, that, in proportion as the pulse was accelerated or retarded, by change of posture, its strength and fulness were affected in an inverse ratio. He thought that an attention to this circumstance might probably assist in forming a more just measure of the strength and fulness of the pulse than any hitherto known, but put this forward merely as a conjecture.

Dr. M'Donnell concluded his paper with an account of several experiments made in descending 26 feet in a diving bell; the result being that no change whatsoever was observed in the number of the pulse or breathing under all the variable degrees of pressure; but that the carbonization upon every volume of the expired air decreased and increased accordingly as he descended and ascended. Hence he infers that man and all such animals can live, if supplied with pure air, under all degrees of increased pressure, and also at all heights, until the quantity of oxygen in the atmosphere becomes incapable of decarbonating their blood.

Dr. Carson and Dr. Collins having made some observations on the circulation in the fœtus,

Mr. CARLILE referred again to the report read on the motions and sounds of the heart, in the course of which he replied to the arguments of Dr. Williams, Dr. Corrigan, and Dr. Carson; when Dr. Corrigan observed, that he thought it would be an unnecessary waste of time to make any reply at present, as some of the Committee were of opinion that the subject was not as yet settled, and required further observations and experiments.

The second paper was from Professor HARRISON, on the curiously-shaped bones which are found in the substance of the heart of ruminant animals. The author first alluded to the circulating organs generally, and contrasted the most striking characters in the four classes of the vertebrata; he then analysed the remarks of several previous writers on the subject of his paper, and showed their insufficiency and inaccuracy; he next exhibited the bones themselves from different animals, and selected those from the ox for particular description. He also exhibited several recent dissections, with the bones in situ, the large or posterior one being imbedded in the septum of the auricles, and the small anterior one just below the root of the aorta, in the fleshy substance of the ventricle: he next alluded to the remarkable fleshy character of the left ventricle in this animal, a transverse section exhibiting the appearance of a bayonet stab, rather than a distinct chamber; with this he contrasted the heart of the horse, where these bones are absent, and a small elastic cartilage supplies the place of the principal. These bones the Professor considered as useful appendices to this very muscular organ, also, that they support the septum auricularum, and prevent the collapse or total closure of these chambers; he further showed that the large mitral valve derives considerable strength from the posterior of them, and that two of the aortic sinuses are floored, and therefore supported by these bones. Dr. Harrison then contrasted the root of the pulmonary artery and aorta, and also alluded to the frequent earthy and bony deposit in man, in or near to those situations, where, in some animals, bone is the natural and essential structure. Specimens of these bones were exhibited in the male and female, as well as in animals only a few weeks old, contrary to the opinions of some writers. The author next made some novel remarks on the very peculiar, hard, and marble-like fat or stear, which is found on the hearts of some of these animals; he showed it was situated over the three sinuses of the pulmonary artery, and that one of the aorta which was deprived of bony

support, and from these facts, and from some experiments he made, he deduced that this adeps, (which also exists in the young animal, and is not confined to the fattened state), is for the purpose of defending or supporting these sinuses against the force of the returning blood, when urged into them by the powerful recoil or resiliency of the large arteries, which in these animals are peculiarly thick and elastic. This paper was listened to with great attention, and appeared to give very general satisfaction.

Dr. HOUSTON read a very original paper, giving a description of several *hydatids*, but more especially of a rare kind, termed *cysticercus tenuicollis*, of which he had found a great number in the omentum of an axis deer which died in the Zoological Gardens at Dublin. Dr. H. described these parasitical animals, as ascertained by mycroscopic observations, and exhibited to the meeting some beautiful preparations, and drawings demonstrative of their anatomical characters and of the morbid changes to which they are subject. The author considers that there is with animals of this class, as with all animated beings, a limit to the term of their existence—a period beyond which they are fated not to retain the condition of vitality. He demonstrated the different stages of the progress of degeneration in those he had examined, from the time of their full grown condition and subsequent death, to a state in which nothing but a small particle of earthy matter remained to show where each had existed. The number and variety of conditions which they exhibited, from that of a translucid animal being, possessing all the attributes of life, to that which Dr. H. looks upon as their final degree of degeneracy—a small bony nucleus,—leads to the conclusion that a long period had elapsed since the development of the first series of hydatids in the omentum of this deer, and that these, having passed away, were succeeded by others, which in their turn gave place to ternary and quaternary formations of the same kind, each equally liable to decay, and running by the same phenomena into the same ultimate states of decomposition. Dr. Houston does not concur with those authors who are of opinion that parasitical animals sometimes degenerate into tubercular or cancerous diseases, or that during their growth they can give any malignant taint to the body of the animal in which they have been generated. He presented to the meeting several preparations exhibiting large cysts full of hydatids in the neighbourhood of the liver in the human body, which, though connected with that organ so intimately as to have caused absorption of a part of its structure immediately adjoining, had sent no roots into its substance, or in any way impaired the functions of those parts remote from the influence of contact. He considers that each individual parasite dies away in the flesh, upon the lapse of the period allotted for its existence; and that it is only by the successive generation of them, in such numbers as to impede mechanically the functions of some neighbouring organ, that they possess any power of doing injury to the constitution of the animal in which they have fixed their habitation.

The fourth paper was from Professor HARRISON, on the peculiar white speckled appearance occasionally found in the muscles of the human subject, and which are now, in consequence of the recent observations of Mr. Owen, considered as animal bodies, or a species of entozoa. Dr. Harrison coincided in these views, and related several cases in which he made careful examination of the body in which these were found in the muscles: he remarked that he never could find any of them in the involuntary muscles, but very few in the mixed, whereas the voluntary muscles, in some instances, were crowded with them; the subjects, too, in which these were present, he remarked, were all emaciated, and showed decided scrophulous characters, such as tuberculated lungs, and diseases of the bones; in one case there was a large cyst in the liver, filled with hydatids.

Dr. ROE, of Cavan, said, that he was called some time back to visit the daughter of a farmer residing at Drum, in the County of Cavan; the girl had been attacked several days previously with inflammation of the thigh, and, at the time of his arrival, was labouring under severe symptomatic fever and delirium. The thigh was tense, red, and shining, enlarged to nearly twice its natural size, and extremely painful. No cause could be assigned for the disease, and he was informed, that until the occurrence of the present attack, she had always enjoyed excellent health. Having ascertained the existence of a collection of matter under the fascia, he made an incision, and evacuated a bowl-full of pus, mixed with what he considered to be clots of blood. His attention was not directed to the contents of the abscess at that time; besides, the room was dark, and he was anx-

ious to give vent to the pus as quickly as possible, as the patient was extremely restless. On emptying the matter from the bowl, on a clean flag outside the door, the girl's mother was surprised to find among it a leech coiled up, quite alive and moving actively. She immediately brought the leech to Dr. Roe, and it continued to live for several days afterwards. On inquiring minutely into the history of the case, I found that, some days before she first complained of the limb, she had been gathering water-cresses in a ditch, and had felt hurt in or about the ankle of the inflamed limb, but did not pay much attention to it at the time. On examining the ankle there was found a triangular cicatrix, such as that which might be produced by a leech bite. This fact would seem to prove that such animals can enter, burrow in, and preserve their vitality in the soft parts of the human body.

A Member asked whether Dr. Roe meant to state that the leech had entered in the manner supposed?

Dr. Roe stated that he did not know any other way in which it could enter. The animal in question was what is called the horse-leech, and which is generally found in ditches and standing pools.

The chairman, Mr. Crampton, stated, that some time since several of the deer at the phœnix park had manifested symptoms of delirium, in consequence of which it was found necessary to shoot them. On opening six of these animals, he had found the trachea in every case filled with worms. The mucous membrane was so thickly covered with them, and they lay so closely together, that at first sight it would be difficult to recognize them; but when the trachea was placed in water, they became loose, and could be easily distinguished. They were pendulous in the trachea, and attached by the head, which bore some resemblance to that of a leech. Several of these worms continued to live for more than three minutes after being detached from their nidus.

In answer to a question from a member, Mr. Crampton said, that the deer were quite delirious, and ran wildly about the park, knocking their heads against the trees. He had examined the brain, but had not been able to find any thing in it to explain the symptoms.

The next paper was from Dr. Jacob, on the structure of the mammary glands in the Cetacea. The object of the author was chiefly to correct some observations by Geoffroy St. Hilaire on these organs. This author assumes that the young of the whale tribe cannot suck the teat of the mother, because it is immersed in water; and then states that the milk is propelled into the young animal's mouth by the action of a subcutaneous muscle upon a reservoir containing the milk, in the centre of the gland. Dr. Jacob shows that there is no great real difference between the mamma in these animals and other mammalia, the supposed reservoir being merely a modification of the enlargement of lactiferous tubes existing in all, and the difference in shape arising from the necessity of adapting the organ to the form of the animal, so that it should not interfere with its progression. He also shews that there is no difficulty in explaining the manner in which the animal sucks under water, and that this can be accomplished even in three different ways. First, by exhausting the cavity of the mouth, closed by the soft palate behind, by depressing the tongue; secondly, by exhausting the mouth by the action of the diaphragm: and thirdly, by the squeezing and pulling of the nipple by the gums of the young animal. In this communication he also called attention to the erroneous notions entertained by anatomists respecting the use and application of the soft palate in the human subject, and shewed that it acts as a valve of double capacity, at one moment closing the mouth behind, and the next closing as effectually the passage to the nostrils.

The sixth paper was a very valuable abstract of a registry of all cases which had been admitted into the Lying-in Hospital during a period of seven years. Dr. Collins was the author of this paper: he had been master of the Hospital during that period, and the document exhibited the valuable results of his close and continued observation of the various facts and circumstances which had come under his notice in the hospital.

The seventh paper was from Sir James Murray, on the effects of atmospheric pressure in the treatment of several local complaints. This paper contained the result of long practical experience as to the efficacy of the increased or diminished pressure of the atmosphere in a great variety of cases. It appeared on discussion that the principal points brought forward by Sir James were already before the public. The Section adjourned at half-past three o'clock.

SECTION F.—STATISTICS.

Lieutenant Colonol Sykes read an interesting paper shewing the rate of wages in Deccan, and the

progressive improvement occurring during later years. The general result of his observations was, that the wages of labourers had been increased, and the price of provisions diminished, since that country came into the possession of the British; and, of course, that the condition of the lower ranks had been ameliorated.

Several Members concurred in thinking that the lower orders often feigned a degree of poverty, which did not really exist, in order to receive additional pecuniary assistance. Mr. Halsewell referred to an instance where a man came to him in the morning to obtain parochial relief, who on the same evening went to the savings' bank to make a deposit of a sum of money, considerable for a man in his station. Allusion having been made to the greater destitution of the Irish than the English labourer, it was observed by a member, that the Englishman was put in a better situation than the Irishman, because he would not submit to the bad, and therefore obtained what was good.

Mr. Babbage stated, that the money amount of wages was not a fair test of the value of labour. He had, when in Italy, employed artisans at 2s. 6d. a day, and it would have been cheaper to pay English artisans 7s. 6d. a day. Estimated by the value of work done, wages were lower in England than in any other part of the world.

A desultory conversation took place on the condition of Irish labourers: among other curious facts, Mr. Turner, agent to the Bank of England at Liverpool, declared that they frequently came to him to get gold for silver, and then sewed the money into their ragged garments, that their possession of it might not be suspected.

Dr. Maunsell read a paper, transmitted by Dr. Vignolles, on the relative number of infanticides before and since the closing of the Foundling Hospital in Dublin. It appeared that the data were not so numerous nor so accurate as to justify any certain conclusions; but, on the whole, the number of infanticides would appear to have increased since that institution was closed.

Mr. Babbage, in accordance with the desire expressed by the Committee, gave his views in reference to the influence of co-operative shops for the sale of necessaries to workmen. He regretted that he could only state the outline of his enquiries, as the notes he had on the subject were made above two years since, and had not been recurred to, and were not with him in Dublin. He, however, produced to the Section the causes which had been deduced from the observations; and as the object was so important a one, he felt it would not be impertinent, even with these materials, to direct attention to it. These co-operative shops were of two kinds:—1st. Those in which the workmen purchased goods at the wholesale price, and retailed them to their families. In this plan the workmen appropriated to themselves the profit of the retail dealer. 2d. Those in which the master kept the shop and the workmen purchased from him. With the latter branch of the case he did not intend to deal at present, but his opinion was hostile to the formation of shops by masters. A few years ago he had access to the concern of Mr. Anthony Strutt, at Derby, and there he found a co-operative shop had been carried on, from the details of which, conclusions, founded on facts, might be drawn. This shop was approved of by the masters, and nothing was wanting to give a fair trial to the experiment. The first requisite was to supply the shop with goods. This was accomplished by the master's guaranteeing the payments to the wholesale dealers at three months credit, and deducting the amount out of the wages due to the workmen at the end of that time. A committee of workmen for buying and selling was formed, and the usual articles of consumption were procured. The rate of profit on the goods varied from 10 to 80 per cent. The number of workmen dealing in the shop at first, and who were of course admitted to share in the profits, in proportion to the extent of the goods they purchased, was largest at the commencement, and then gradually declined. The amount sold was at its *maximum* the second year, and then gradually diminished, until at the expiration of fourteen years the shop was closed up. He (Mr. Babbage) inquired what were the causes of this failure, and on being informed of them, they appeared sufficiently valid. The committee of workmen commissioned to purchase, although good judges in their usual mechanical departments, showed no equal ability in purchasing bacon, flour, meal, &c. and the regular dealer was of course always able to make a better purchase. If they endeavoured to acquire skill in buying such articles, their attention was distracted from the proper and more profitable avocations. The next cause of failure, and the most important was, the demoralizing effect produced on some members of the committee. Coming in contact with those who sold

wholesale, it was natural that little favours should be conferred upon them to secure their custom, and thus men got corrupted. The practice in this respect became so notorious, that a significant word was used to denote it: it was called "greasing." Books were kept at the shop, in which the amount purchased at each time by each customer was entered. The wives and children of the workmen made their little purchases at the shop, but no money passed between the parties, and only the balance of wages due to them came into their hands, the larger portions of course being paid to the shop on their respective accounts. Some inconvenience arose from the want of a circulating medium. A child who by its industry used occasionally to bring to its parents, on the Saturday night, a few pence more than its average earnings, would sometimes take that opportunity to petition for a small part of the surplus for some innocent gratification, and the indulgence acted as a stimulant on its future industry: but when its gains were merely entered in a book to the credit of the parents, no opportunity was offered for such requests, and additional industry became less apparently rewarded. Mr. Babbage concluded by stating, that the result of this experiment, made with most benevolent views, assisted but not governed by the proprietors of the factory, and carried on by the workmen themselves for a long period of years, induced him to believe that there were very few circumstances in which such establishments were favourable to the interests of the workmen. He wished, however, that the very imperfect sketch he had given might induce other gentlemen to collect facts on a subject of the greatest importance to the happiness of the working classes.

Several members joined with Mr. Babbage in the view he had taken, and instanced various cases where the plan had been adopted and failed. One case alone had been adverted to, Plymouth, where a shop for the purchase of bread by the workmen continued to flourish; but this was attributed to the superintendence of some officers in the management. Another reason assigned was that the value and quality of the materials for bread were well known, and did not require much experience.

Dr. ORPEN concurred in the objections made to co-operative shops, and observed that every man should take care of himself.

Mr. BABBAGE stated that the view of the case suggested by the last speaker, reminded him of one remark which he had omitted to make. The persons buying at these co-operative shops, took the goods without examination of their quality, conceiving that no necessity existed for such examination, and when they came afterwards to purchase elsewhere, they were deficient in caution in making a judicious and favourable selection of whatever articles they required.

DINNER AT MORRISSON'S.

At five o'clock three hundred persons sate down at the ordinary at Morrisson's, where a most excellent dinner was provided. The President of the British Association took the chair. On his left were Sir Thomas Brisbane, M. Agassiz, Dr. Peithman of Berlin, Mr. Greenough, Professors Alison and Graham. On his right the Surgeon-General, Professors Moll, Powell, Sedgwick, Mr. Babbage, &c. &c.

After dinner the President proposed—

"The King," which was drunk with three times three.

The President, after a few complimentary observations, in reference to the advantages science would derive from this meeting, proposed—

"Success to the British Association"—drank with three times three.

The President next gave the health of—

"The late President, Sir Thomas Brisbane"—drank with three times three.

The next toast offered to the assembly was the health of the illustrious foreigners and of the Americans present at this meeting—(cheers and laughter)—drank with the utmost enthusiasm.

Dr. PEITHMAN, of Berlin, was the first to rise in acknowledgment of the honor conferred upon him. He briefly expressed the gratification he had experienced upon this his first visit to Ireland.

Professor MOLL next rose to express his gratitude for the kindness with which he had been received. He could not attribute it to any merits of his own, but he believed Irish hospitality was evinced in a greater degree, the more distant the place from whence the object of their hospitality came—(loud applause.)

Monsieur AGASSIZ stood up and addressed the assembly in his native tongue. He expressed himself with much energy in praise of England, and the efforts her learned men had made to advance knowledge, an end to which all the scientific men of Europe were directing themselves. He thanked the company for the enthusiastic reception he had

met with, and concluded by exclaiming most ardently—

Vive L'Association Anglaise!

Colonel DICK, of America, next offered himself to the attention of the meeting, and on the part of his country thanked the assembly. An observation in reference to America, which was made that evening, attracted his attention. It went to show that Americans were not considered by Irishmen so distant as foreigners—(hear and cheers.) A similar feeling, he was happy to be enabled to say, existed in the new world towards Ireland—(applause.) America was making great strides in literature and the sciences. Such an association as this was well calculated to stimulate her sons to greater and more strenuous efforts—(hear.)

The number meeting together this day for dinner being greater than could be accommodated in Morrisson's large room, an additional table was laid in the room adjoining, and the members dining there seemed to enjoy the scene quite as much as those who composed the larger assembly.

GENERAL EVENING MEETING AT THE ROTUNDA.

In the evening the Round Room of the Rotunda was densely crowded. Nothing could be more brilliant than the appearance presented on this occasion; the desire of hearing and seeing the eminent men in this city, appeared to increase instead of diminish.

The President said that the real business of the Association was transacted at the various sections, but an abstract of the proceedings which occurred there, would now be given the meeting.

The reports of the sections were read by Doctor Robinson, Dr. Apjohn, Mr. Griffith, Dr. Graham, Dr. Harr ison, and M Babbage.

The reports having been concluded, the PROVOST addressed a few words to the meeting. He congratulated the Association on its splendid success. The reports they had just heard were most gratifying proofs of the progress they were making in every department. He (the Provost) not having the power of multiplying himself, could only be present at one section. He had selected the mathematical, and he felt convinced from what he had witnessed in that one section, that never had science advanced so rapidly as within the last few years (applause.) And he was convinced further, that this was mainly attributable to the existence of the British Association (great applause.)

Mr. POWELL was then called on to state to the meeting the results of his researches on the dispersion of light, according to the undulatory hypothesis; and on his coming to the front of the platform he was received with cheers.—He began by stating that he had a two-fold apology to make to the meeting; first, he had to apologise for not having brought with him diagrams, whose proportions would be better adapted to the size of the magnificent room in which they were assembled; not, however, having been aware of the size of the apartment in which he would be called on to exhibit them, he had prepared them on a scale so small that he feared they would be totally invisible to those in the remote part of the room. He had another apology to make, and that was for the abstruse nature of the subject. He felt how deficient in interest his statements would be when compared with the clear, luminous, and brilliant lecture which had been delivered in that room last night. He had nothing to offer which would be interesting as capable of practical application. He had no details with regard to the velocity of locomotive engines—no interesting description of new railroads—no promise of a high-way to New York—(hear and cheers.) He had not to recount those great and glorious triumphs which intellect had achieved over the obstacles of the material world, by the employment of mathematical calculations in the construction of mechanical movers; he must occupy the meeting with cold, dry abstractions, utterly unconnected with popular subjects, and interesting only to those who had directed some attention to these subjects—to those who prefer simple truth for its own sake (cheers.) But though these subjects had no imposing brilliancy to dazzle the attention, they yet had a claim of their own, a peculiar, a sublime, he might almost say, sacred interest to every well regulated mind, independent of that love of abstract truth for its own sake, to which he had already alluded. These investigations led to consequences whose sublimity made them grand. Here they found that the same mechanical forces pervaded bodies on the surface of the earth, and acted in the most remote regions of space. Upon these considerations he could not dwell; yet it was grand to think that the same properties which are found in each minute particle

of matter, were the properties which regulated all the magnificent arrangements of the material universe. The phenomena of light, upon which he must speak, had been subjected to the most searching investigation by the aid of the refined analysis of modern contrivance; and its properties, even as they existed in the most remote parts of the universe, were ascertained with all the certainty that belonged to the conclusions of astronomy. He should now proceed to facts: first, however, he should perhaps mention another circumstance which lent additional difficulty to these subjects, and that was the extreme minuteness of the particles which became the subject of inquiry. At all times these inquiries into the very minute parts of nature were received by the vulgar with distrust and ridicule. At the dawn of philosophical investigation, when first the theoretical precepts of Bacon were reduced to practice by Robert Boyle, the father of experimental science, he was ridiculed for the minuteness of his inquiries; but that great man replied to these taunts in words deserving of eternal commemoration—in words that might well stand as the motto of the British Association. "Nothing can be so minute as to be unworthy of the investigation of man, which was not unworthy of being created by God." (cheers.) He would now pass from these general topics to the more immediate subject upon which he was to speak. All present were probably aware of the common phenomena of the prism; the principle facts had long been known to the Ancients. Newton was the first to follow up these facts, and he found that a ray of white light was compounded of different rays, and that each ray possessed a peculiar property, both of colour and refrangibility. The broad fact was thus ascertained, that the rays which differ in colour differ also in refrangibility; this fact remained in the hands of his successors pretty much as it had been left by Newton, until the beginning of the present century, when Dr. Wollaston observing the prismatic spectrum under peculiarly favourable circumstances, discovered that the rays were not only separated, by refraction so as to form the spectrum, but were absolutely separated and divided by dark lines. This investigation being followed up, it was found, at a more recent period, that these lines were more numerous than had been at first supposed; that, in fact, the whole spectrum was a continued series of these lines; some, however, preserving their more prominent appearance under every circumstance, so that they might easily be distinguished by names. This is a most important point in all scientific investigation, to have a fixed nomenclature, and accordingly the lines were designated by the seven first letters of the alphabet. These lines, however they might vary in their relative distance, according to the different substances of which the prism was formed, always preserved the same locality in the spectrum as to colour. We thus gained fixed and definite points; no matter what was the medium of refraction—no matter of what substance the prism was formed, these lines preserved their position as to the respective colours. By changing the substance of the prism you alter the nature of the spectrum and the position of the colours; by employing either the light of the sun, or that same light reflected from the clouds, or the light of the electric spark, you made alterations in the spectrum; but these points in all cases preserved their position as to the colours. With the theories that had been advanced to account for these dark lines he had nothing now to do; it was with their uses he was concerned; and they served this all important end—that by their means the different points of the spectrum could be identified accurately, while Newton had been compelled to speak only of the coloured rays. At the first meeting of the Association, Sir David Brewster had complained of the want of a fixed nomenclature, and this he (Mr. Powell) had also found a great difficulty. He had now prepared a standard scale—(Here, and at many other parts of his lecture, the learned professor referred to his diagrams—without a reference to which much of what he said would be utterly unintelligible.) According to the substances of which the prism was composed, the spectrum had a different elongation. (Professor Powell here exhibited the relative appearances of the spectrum when the light was refracted by water, oil of turpentine, flint glass, oil of anniseed, oil of cassia, sulphuret of carbon, and some other substances; the differences were brought into striking view as they were placed side by side.) The question then was, did these appearances follow any fixed or definite law?—was there any principle of regularity? The learned professor then exhibited on a board the mathematical formula by which M. Cauchy had connected the refractive indices of the light of different colours with the lengths of their waves, according to the principles of the undulatory theory.

He then exhibited a table of his own observa-

tions, which, he said, he had drawn up in a hurry for this meeting. He had tried with ten different substances, and in all he found the relation which had been deduced by these mathematical calculations to hold good; he thus thought that there appeared that coincidence between theory and observation which justified us in believing that we had attained to the truth. He alluded to the labours of Professor Airy—no longer Professor Airy, but Astronomer Royal of Great Britain—(cheering)—and to a paper which he had himself presented to the Royal Society of London; but the whole of the latter part of his address, in which he attempted—and, we believe, successfully—to reconcile the phenomena of the dispersion of light to the undulatory hypothesis, would have been much better fitted for the Physical section than the mixed audience he addressed at the Rotunda. When he had concluded,

Professor HAMILTON addressed the chair. He was sure that every one must be satisfied that the learned gentleman had not exaggerated the importance of his inquiries, and certainly not his own success in their prosecution. He was really astonished. A revolution had been effected in optical science; a few months ago the phenomena of the dispersion of rays had been the chief difficulty in the adoption of the undulatory hypothesis; they had now been brought to the other side, and afforded its strongest confirmation; theory had absolutely outrun experience, and calculation had anticipated the results of observation. The learned Professor concluded by passing a high eulogium upon the talents and industry of Mr. Powell.

Mr. WHEWELL was then requested to favour the meeting with the result of his inquiries on the subject of tides.—He said that however unreasonable it would be now to trespass long upon the attention of the meeting, yet he could not deny that this was a subject upon which he would feel a pleasure in occupying any time that might remain unappropriated to other subjects. He had before the honour of bringing this subject before the Association, and it was one which he might say was under the protection of the Association. He felt pleasure now in giving an account of what he had done since the last meeting; not that it was much in quantity, but it was of a nature that exhibited both the process of all scientific advancement, and also illustrated the importance of united efforts. Perhaps the progress that had been made in this department would be more readily apprehended if he begged the meeting to attend to some general laws that invariably regulated the progress of knowledge. Art was always found to precede science; men applied the properties of nature without troubling themselves to understand them. Then came the observation of detached phenomena—then of the laws which regulated these phenomena, but still without any inquiry into their cause: laws were then arrived at, which a great modern philosopher had designated residual phenomena; and then lastly came the inquiry into causation, and the investigation into the still more general principles upon which those laws were based. Bearing this sketch of the general progress of science in mind, we might by a very few words understand at what point of it we now stood as respects tides. First had been constructed tide tables—constructed by some rules not generally known, but rules learned and employed as a craft; these were superseded by more accurate tables, constructed on principles of science; and then there was a reference to the influence of the lunation, and to the laws which regulated the phenomena of tides. But these laws were deduced from observation of the phenomena themselves; tables had been kept for nineteen years in the port of London, and at Liverpool these tables were regularly kept for a long series of years. The British Association, impressed with the importance of the subject, had allocated a portion of their funds to the printing of these tables; it was since his (Mr. W.'s) arrival in Dublin that the first proofs of the printed tables had been transmitted to him. He could not but advert to the obligations which the Association owed in this matter to those persons with whom they had to deal; they had allowed the original manuscript, which was of course of great value, to be transmitted to London, for the purpose of having the observations reduced to a abular form, (hear, hear, hear); and the corporation of Liverpool, with a praiseworthy liberality, had ordered observations to be made in future at their expense, (loud cheering.) He must also mention that, through the influence of M. Arago—an influence exerted on account of his connexion with the Association—they had obtained from the French government observations of great value, which had been preserved for a very long series of years at Brest—(loud cheers.) It was a curious circumstance, that when the attention of the scientific world had been first turned to the tides, observations had been

simultaneously begun under the direction of the Royal Society of London, and of the Parisian Academy of Sciences. These observations had been continued for some time, until, finding either the problem too difficult, or the perseverance too tiresome, the observers had almost all abandoned their undertaking, without furnishing sufficient data for arriving at a final and valuable result. There were two objects of inquiry with regard to tides: first, the laws of their relation to time—and, secondly, to space. Attempts had been made to ascertain the rate at which the tide travelled, but as yet they had been ineffectual. In June, 1834, observations had been ordered to be made by the coast guards along the coasts of Great Britain and Ireland; returns had been thus procured from five hundred different stations.—The reduction of these had been only partially effected, because the public office to which this business belonged had been otherwise occupied. The arrangement of this was very laborious, and it had devolved upon him (Mr. Whewell). In one respect he had been overruled: he thought that the first observations should be made upon the western coasts of Ireland. The tide first visited the shores of Ireland; and, like every thing Irish, it was naturally more pure and unsophisticated than after it had reached, through many disturbing intricacies and by many tortuous passages, the more fashionable quays of London and Edinburgh—(great laughter and cheering.) It was his (Mr. W's) wish that the results should first be obtained of the observations on the tide that washed the shores—he could not help adding, the hospitable shores—of Ireland—(cheering.)—but, for some reason, the government preferred beginning with the south of England. In the paper which he held in his hand he had drawn up his conclusions from these observations; they had done this much, that they had thrown a great light on the circumstances attending the meeting of the two tides—the one which ran up the British Channel, the other (we believe) from the Northern Ocean. This was a subject of inquiry equally interesting to the man of science and the navigator. In June, 1835, fresh orders were issued to continue these observations along the same extent of British coast, and application for assistance had been made through the ministers of foreign powers; in every case they had been cordially met; and there was not a maritime state in Europe, not one north of the equator, that was not contributing its assistance to this great work. Sweden, Denmark, Russia, Spain, France, Holland, and the United States, had all joined in it—(cheers.) He could not but express his gratitude for the labours of one foreigner, who was now present, he meant Professor Moll, of Utrecht—(cheers)—who had furnished them with many very valuable returns from the coast of Holland—returns procured by much personal exertions. Monotonous, and calm, and tranquil as the life of a man of science might appear, his inquiries were sometimes agreeably diversified by incidents of danger: the boat in which the Professor used to make his observations had been on one occasion swamped by the tide which he was examining; but fortunately for the interests of science, the crew were saved—(cheers.) By the next meeting of the British Association he hoped that the inquiries commenced under these favourable auspices will have led to some valuable results. He begged the meeting to bear in mind the general law which he had stated of the progress of knowledge: from arts to phenomena—from phenomena to laws—from laws to causation. It was true it might be said, that the cause of the tides was already known to be the attractive influence of the sun and moon; but then, this had not been ascertained by the observation of the tides. These influences had been discovered in inquiries of another character, and in the investigation of phenomena, even in point of space, far remote from the tides on this world; and so discovered, they had been applied to the solution of the phenomena of the tides. But he would go further, and say, that no one would, even now, be hardy enough to hazard the assertion, if it rested on the unsupported evidence of the tides themselves. We knew, indeed, generally, that these influences caused the tides; but still we had not traced through all the details of mechanical causation the mode in which these influences produce the various phenomena these tides presented. Laplace, the greatest mathematician of his age, had been unequal to the task of these complicated calculations. He could not avoid mentioning, in connexion with this subject, the paper read by Mr. Russell, in the Physical section. Mr. Russell had successfully investigated the laws regulating the propagation of waves, and had shown the relation between the velocity with which the wave travels, and the depth of the water—no matter how long the canal, even were it as long as the Atlantic. Thus, could we ascertain the depth of the Atlantic, we would know the rate of the tide. But, might we not reverse the process, and ascertain the

depth from the rate? Here then was another instance of the relation of all the sciences, and geology would be indebted for this important knowledge to mathematical and physical investigation. Nay, more, (continued the learned Professor,) when the British Association shall meet, two hundred years hence, perhaps in this very room—for meet at that period I am convinced it will—(great cheering)—the individual who shall then occupy the position which I do now, shall turn to the geologist, and, telling him the rate of the tide—a rate, perhaps, very different from that at which it travels now,—will calculate for him the depths of the ocean; and thus the geologist shall know, with accuracy, the secrets of those depths where no plummet ever sounded, and no line was ever cast, explored by the power of this liquid lever, which the investigations of physical science had placed in his hand. (loud applause). And when they look back to our proceedings at this period, they will, I hope, in returning to next year's meeting, be able to calculate the depths of the ocean back for two hundred years, and thus ascertain for that period the geological changes in the fathomless caverns of the great deep. (applause.)

MEETINGS OF THE ASSOCIATION, THURSDAY, AUGUST 13.

SECTION A.—MATHEMATICS AND PHYSICS.

The first communication was a report by Mr. Baily, of a comparison of the Aberdeen standard scale of five feet long, made by Troughton, with the standard scale of the Royal Astronomical Society. This comparison was made at the request of the British Association at its late meeting at Edinburgh, and had since then acquired an importance which had not at the time been at all anticipated, in consequence of the destruction of the parliamentary standard of these countries by the late calamitous fire in the houses of Lords and Commons. The middle of the scale of the Royal Astronomical Society had been previously compared with the imperial standard; with that part of it, therefore, alone it was determined to make the comparison with the Aberdeen scale. The report then went on to state the precautions used in order to ensure accuracy, and the result was most gratifying and satisfactory, as the very near coincidence of the results obtained by different observers most clearly evinced.

Mr. Snow Harris then gave an account of his observations upon the thermometer at Plymouth, and taken every hour both of the night and of the day, since the first of May 1832.

Mr. Harris laid before the Section manuscript tables containing upwards of 30,000 observations of the thermometer taken every hour, night and day, for three years. From these observations many valuable results had already been obtained; and a comparison of them, with similar observations conducted at Leith harbour, under the superintendence of Sir David Brewster, had been attended with the most gratifying comparative results. Mr. Harris explained how, by taking a mean of all the observations for each hour in succession through the twenty four, and marking down these means by points on a sheet of paper—previously divided by twenty-four equidistant lines running from the top to the bottom, to denote the successive hours of the day, and then divided across by a number of equidistant lin es sufficient to denote the number of degrees upon a thermometer between the lowest and the highest mean diurnal temperature ever observed at Plymouth—by joining these points, a curve is obtained which may be called the mean diurnal curve of temperature for that place. To speak the language of mathematicians, the abscissæ were the successive hours of the day, and the ordinates were the mean heights and depressions of the thermometer above and below the mean temperature of the place at the several hours represented by the abscissæ. The general results stated by Mr. Harris were these: The curve crosses the line of mean temperature at 12 minutes past 8 A.M.; it then rises up farther and farther from the line of mean temperature until about 1 P.M., when the mean diurnal maximum is attained. It then returns again, reaches and crosses the line of mean temperature, at 19 minutes past 7 P.M.; then sinks more and more below the line of mean temperature, until 5 o'clock in the morning of the succeeding day, when the mean diurnal minimum of temperature

is obtained, and it then rapidly rises, until, at 12 minutes past 8 A. M., the curve again crosses the line of mean temperature.

Mr. Harris had also been at the pains—since there was some difference between the mean diurnal curves for the winter six months beginning with November, and the summer six months beginning with May—to draw a distinct curve for each. To show the correctness of the principle on which these curves are constructed, and the harmony that exists between them when representing the mean diurnal variations of the thermometer at distant places, he exhibited on the same sheet, but in a differently coloured ink, the curves obtained for Leith under the superintendence of Sir David Brewster; and while the general resemblance of the curves belonging to the two places was most obvious and striking, the clear conception which almost a single glance was sufficient to give, of the diversities of the minute circumstances of the diurnal variations at the different stations, was no less striking than interesting.

The principal differences between the Leith and Plymouth curves were, as far as we could catch them, that the extreme variations of temperature were greater at Leith than at Plymouth; and that there was also some difference as to the hours of maximum and minimum temperature at the two places. Mr. Harris then examined the nature of the four branches of the curve, and showed, by a comparison of the ordinates and abscissæ of each, that each could he very accurately represented by a branch of a common parabola, but the four branches had obviously each a distinct parabola for its type.

Mr. Harris also exhibited to the Section a table showing the deviations of the means of similar hours taken A.M. and P.M. from the mean of the entire day. The reading of this communication, and the exhibition of the curves, excited much interest in the Section.

Professor HAMILTON then read, and very ably commented on a communication which he had received from Mr. G. B. Jerrard relative to the grand desideratum in pure Mathematics, the finite resolution of equations of the higher orders. The solution of cubic and biquadratic equations has been known for nearly three centuries; but all attempts which have hitherto been made to proceed beyond them, have been altogether unsuccessful, although (in the words of Mr. Peacock) "this great problem has been subjected to the most scrutinizing and laborious examination by nearly all the greatest analysts who have lived in that period." The illustrious Newton failed to solve it, and was obliged to have recourse to *approximate* methods. Towards the conclusion of the last century, Lagrange attacked it with all the advantages of an improved analysis; but finding that it not only entirely eluded his grasp, but presented theoretical difficulties to all appearance insuperable, he pronounced it to be "*presqu' impossible.*" Since his time this celebrated problem has been generally regarded as incapable of solution—and, indeed, analysts of note in Italy, France and Germany, (Ruffini, Cauchy, and Abel,) have severally put forward what many have conceived to be *demonstrations* of its absolute impossibility.

Professor Hamilton first explained the methods hitherto in use for solving cubic equations rigorously, and higher equations by approximation. He then stated that it was always possible to eliminate certain terms in every equation, by introducing a new unknown quantity which should bear a known relation to the actual unknown quantity or root of the given equation. Mr. Jerrard proposed to prepare the equation of the fifth or higher degree for solution in this way—by the introduction of certain quantities, the notation for which is of a very novel and expressive kind, depending upon the properties of the symmetrical functions of the roots of the equation. Professor Hamilton expressed himself in terms of high approbation of the ingenuity and entire originality of the method, although he hesitated to pronounce, as yet, a decisive opinion on a subject of such extreme difficulty; the only doubt at present on his mind was, lest the denominators in the expressions obtained should vanish, and thus the formulæ become illusory. In the course of his masterly exposition of the theory, Professor Hamilton repeatedly expressed his admiration of the powers manifested by Mr. Jerrard, both in the invention and in the applications of his beautiful and comprehensive system of notation.

Doctor JERRARD of Bristol College, returned thanks to Professor Hamilton, for the very lucid

manner in which he had explained his brother's views on this very abstruse subject.

Professor PHILLIPS presented a report of the results of a third series of twelve month's experiments, on the quantities of rain falling at different heights in the atmosphere. The experiments formerly discussed, (see vols. 2 and 3, Report of the Association) having made known the general fact of the regular diminution of the quantity of rain, as the stations are taken higher and higher *above the ground*, and the dependence of this diminution upon the temperature of the season of the year, it was proposed by a third series to obtain data for a precise determination of the law representing the phenomena. To guard against any error which might be imagined to affect the results, through the unknown amount of evaporation from the gauges, particular experiments were instituted and continued for seven months, so as to prove satisfactorily that no sensible error from this cause would vitiate the investigation. It was ascertained that from open vessels, the rate of evaporation was greatest at the higher 'stations, and least on the ground. The calculations founded on the experiments of three years led to a simple formula, which expresses with remarkable exactness in terms of the height, and mean temperature of the season and of the year, the following and other results :—

The *quantities* of rain received upon equal surfaces on level ground, and at different heights above it, are greatest on the ground, and least at the highest station above it.

The *diminution of the quantities* at the upper stations is variable with the temperature of the season, being greatest in the cold months, and least in the warm months.

The *ratio of the diminutions at different heights* (as compared with the standard quantity on the ground) is variable with the temperature of the season.

It appears possible to obtain by a combined system of observations, framed in accordance with the indications given by the experience already gained, sufficient data for the foundation of a mathematical theory of the condition of an elementary rain-drop at each point of its descent; an investigation of great importance, since it would, of necessity, disclose the condition of the atmosphere as to temperature and moisture to a considerable height.

A plan of combined operations, and a skeleton register for the results, including columns for collateral obervations, were then submitted by Professor Phillips.

After the reading of this paper an animated conversation took place, chiefly consisting of statements of facts confirmatory of the views and results of Professor Phillips.

Colonel SYKES then proceeded to describe a very simple apparatus by which he had long been in the habit of finding the heights of elevated stations by the aid of the common thermometer, on the principle first used by Wollaston, that the boiling temperature of water is lower as the atmospheric pressure to which its surface is subjected is diminished. He stated, that every person who had ever used it knew that Wollaston's apparatus was very expensive in its first cost, and very liable to meet with accidents, and be broken from the excessive weight of its bulb. Now Colonel Sykes found, that a good common thermometer, with a moderately long scale, was quite sufficient for all ordinary practical purposes. His simple apparatus was a common tin shaving pot, and a tin cylinder which fitted its upper orifice when about one-half of its length had descended into the shaving pot. The upper part, or cover, of this cylinder was furnished with an oblong opening for receiving the thermometer, and sustaining it with its bulb in the water, which is made to boil in the shaving pot; the upper part of the scale of the thermometer being kept above the lid, so as to be readily seen. The heights are then obtained from the boiling points, by tables which are of easy access. He exhibited to the Section a comparison of the heights of certain elevated stations taken by the aid of his simple apparatus, with the heights of the same stations taken by methods of admitted accuracy, and in general the difference was only a very few feet, and never so great as to be of any practical importance.

Mr. M'CULLAGH gave a short account of some recent investigations concerning the laws of reflection and refraction at the surfaces of crystals. To understand the nature of the general problem which a complete theory of Double Refraction requires to be solved, let it be supposed that a ray of light is reflected and refracted at the separating surface of an ordinary medium and a doubly refracting crystal; the light passing out of the former medium into the latter. This limited view of the subject is taken merely for the sake of clearness of con-

ception; since we might suppose that both media are crystallized, without increasing the difficulty of the problem. The question, it is obvious, naturally divides itself into two distinct heads. The first relates to the laws of the *propagation* of light in the *interior* of either of the two media, before or after it has passed their separating surface; and this part of the subject has been fully treated, according to their different methods, by MM. Fresnel and Cauchy. The second division of the subject had been left completely untouched. It relates to the more complex consideration of what takes place at the separating surface of the media; the laws according to which the light is there divided between the reflected and refracted rays; including a determination of the attendant circumstances indicated by the wave theory, with regard to the vibrations in the reflected and refracted rays. In the case above mentioned, when the incident light is polarized, there are four things to be determined, namely, the *magnitude* and *direction* of the reflected vibration, with the *magnitudes* of the two refracted vibrations. The four conditions necessary for this determination are furnished by two new laws, which could not be easily stated without entering too much into detail. The results, applied to determine the polarizing angle of a crystal in different azimuths of the plane of reflection, agree very closely with the admirable experiments of Sir David Brewster on Iceland spar. In the course of these experiments it was observed that the polarizing angle remained the same when the crystal was turned half round (through an angle of 180°) although the inclination of the refracted rays to the axis of the crystal was thereby greatly changed. This remarkable fact is a consequence of the theory. After some complicated substitutions in the primary equations, the value of the polarizing angle is found to contain only *even* powers of the sine or cosine of the azimuth of the plane of reflection, and therefore a change of 180° in the azimuth produces no change in the polarizing angle.

The two new laws above mentioned, on which the theory depends, occurred to the author in the beginning of last December; but owing to an oversight in forming one of the equations, they were not fully verified until the beginning of June.

In this theory it is supposed that the vibrations of polarized light are *parallel* to the plane of polarization, according to the opinion of M. Cauchy. This is contrary to the views of Fresnel, whose theory of double refraction obliged him to adopt the hypothesis that the vibrations are perpendicular to the plane of polarization. It is further supposed, that the density of the vibrating ether is the same in both media; and this hypothesis of a constant density in different media, which was found necessary for the theory, seems to accord, better than the supposition of a varying density, with the phenomena of astronomical aberration.

If we conceive the three principal indices of refraction for the crystal to become equal, we shall obtain the solution of a very simple case of the general problem with which we have been occupied—the case of an ordinary refracting medium, such as glass. This simple case, it is well known, was solved by Fresnel. The foregoing theory leads to a simple law, expressing all the particulars of the case, but differing, with regard to the *magnitude* of the refracted vibration, from the formulæ of Fresnel. The law may be stated by saying, that *the refracted vibration is the resultant of the incident and reflected vibrations;* the first vibration being the diagonal of a parallelogram of which the other two vibrations are the sides, just as in the composition of forces. The plane of this parallelogram is the plane of polarization of the refracted ray. It is to be remembered, that the vibrations in each ray are perpendicular to the ray itself, and *parallel* to its plane of polarization.

This simple case has also been considered by M. Cauchy, in a short paper inserted in the *Bulletin Universel*, tom. xiv.; but it does not seem to have been observed by any one that his solution is erroneous. His formula for light polarized parallel to the plane of reflection, is that which belongs to light polarized perpendicular to the plane of reflection; and *vice versâ*.

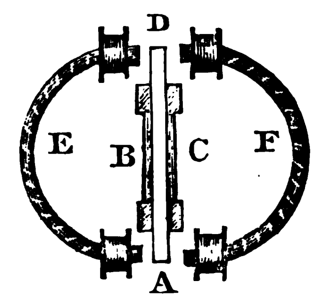
The Rev. JAMES WILLIAM M'GAULEY then read "an enquiry into the possibility and advantage of the application of Magnetism as a moving power, with remarks on the nature of Magnetism." He believed that an enquiry into the possibility of applying Magnetism as a moving power, to be available to its fullest extent, must necessarily be accompanied by an examination of its real nature. In considering its applicability as a moving power, two questions of great importance must arise—

the quantity of magnetic force we may command, and the cheapness of its production. He did not of course contemplate the creation of a power, like that which had been already obtained in magnetic rotations, and similar contrivances, such could never be effective; for in these the force is not directly applied, or is applied at such a distance, or in such a manner, as that almost an indefinitely small portion of the lifting power of the magnet is available. Such an enquiry as the one now instituted, however important it may ultimately become, or whatever changes it might ultimately produce is, after all, only a search for a more advantageous means of applying a power we have long possessed, and hitherto by different means have universally adopted; for it seems easy to demonstrate that the wind-mill, the water-mill, the steam-engine, &c. derive all their efficacy from these very electrical properties of matter, which constitute the subject of the present enquiry, and which it is intended, if possible, to render yet further and more cheaply useful. He did not expect that Magnetism would arrive at once at that perfection, which, if we read the history of the Arts and Sciences, we shall find is not ever suddenly attained with human inventions, or in human things; neither did he believe that, if he should not reach the object he at first contemplated, this Mechanism and enquiry, would by consequence become entirely useless, since the best and noblest discoveries we can boast, are known to have derived their origin not unfrequently from unsuccessful experiment, or at least from the slow development of some important principle, discovered by chance, and perhaps long neglected, or nearly forgotten. The vibrations of the pendulum carrying the soft iron bar in the machine he exhibited, were proportioned in rapidity, for a given time, to the quantity of electricity, and might therefore be made the easy and accurate measure of electricity produced by a given voltaic combination, or the comparative conducting power of various substances. He would, for the sake of greater clearness, divide his subject, and should speak first of the quantity of Magnetism we can create, and its available portion; second, of the facility of its production, for the present, at least, dependent, or the reversion of the magnetic poles, the iron, the battery, the helix, but hereafter perhaps, or its real nature, a more perfect knowledge of which may ultimately alter the method of producing it. 1. As to the quantity, since we may combine any number of powerful magnets, he had little hesitation in saying, that it can have no limit. 2. As to its cheapness, a very trifling electrical apparatus suffices even now for its creation, very weak dilute acid, or common sea water, afford us the means of exciting this; and an attention to a few simple facts will enable us to produce a magnetic action, perfectly uniform, and of whatever force and duration we may desire. He thought that previously to his describing the Electro-magnetic Machine, they had seen at work, it might not be altogether uninteresting, to throw an hasty glance, at some of the principal obstacles he encountered in its construction. The greatest of these seemed to be, the disturbing influence which magnets of any power exercise over each other, and which renders the reversion of their poles a matter of great difficulty. He had attempted to reverse the poles of one Electro-magnet in contact with another, the sudden rush of electricity in a contrary way, evidently effected such a disturbance of polarity, as caused a magnetic needle in the neighbourhood of the magnet to be very much agitated, but it produced no permanent change, no repulsion, nor separation of the Electro-magnets; this in truth might have been expected, since the mutual action of Electro-magnets and their keepers, exactly resembles the mutual action of the coatings of a leyden jar. He brought into contact the similar poles of two Electro-magnets of very different power; they attracted each other, the poles of the weaker magnet were reversed, and a counter current through its battery, was formed by the induction of the larger magnet, and indicated by a galvanometer making part of the circuit. He magnetised by a galvanic current only one of the above-mentioned Electro-magnets, and easily reversed its poles, during the reversion the other Electro-magnet, acting merely as a keeper, was thrown off and attracted with considerable violence; he then suspended between these semicircular Electro-magnets a bar of soft iron, its extremities lying between their poles in such a manner, as that when repelled by one magnet, during the reversion of the poles of both, it should be attracted by the other. He placed between the same magnets a bar of magnetised steel, but the effect was much less powerful, because the bar of soft iron acquired by induction a much stronger attractive force than the steel bar possessed.

2. The limited space within which magnetic attraction or repulsion is confined, presented a very considerable difficulty; the attraction of a magnet is inversely proportioned to the square of the distance, at the distance even of $\frac{1}{8}$ of an inch, the attraction of a powerful magnet is comparatively small; a stroke of $\frac{1}{8}$ inch, communicated to machinery were nothing, we must therefore increase the stroke, but at the same time diminish the power as little as possible. If we increase the length of the stroke by increasing the distance between the poles of the magnets, we diminish the power as the square of the increased distance, but if we apply the magnetic force at the shorter end of a lever, we diminish it only in the simple proportion of the longer to the shorter arm of the lever; thus, if we desire to increase the stroke 12 times,—from $\frac{1}{8}$ to $1\frac{1}{2}$. Let P be the power with the smaller distance D, and P′ the power with the larger distance D′ then as $P \propto \frac{1}{D^2}$, $P : P' :: 144 : 1$, when we increase the distance between the poles of the magnets,—but increasing the stroke by applying the magnetic force to the shorter arm of a lever $P : P' :: 12 : 1$. In the former case we diminish the power 144 times, in the latter only 12 times; the disparity between the power and effect is still greater when the difference between D and and D′ is increased. It is evident that in any circumstances the power must be a good deal diminished, but this is of little consequence, since we can easily produce it in enormous quantities, and since from the facility we possess of reversing the poles, the rapidity of motion we may command is all but unlimited. The repulsion of the magnets though much less than their attraction is considerable, and must not be forgotten in calculating the power of an Electro-magnetic Machine.

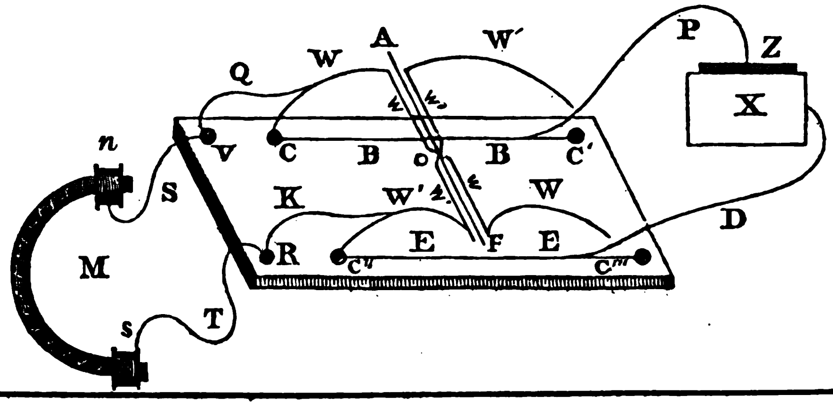
Mr. M'Gauley then remarked, that the construction of the aparatus by whose action he had exhibited to the section, the possibility of applying Magnetism as a moving power, must after these preliminary remarks be easily understood. The mechanism it has seen had been put in motion by a very small quantity of weak dilute acid, its motion was stopped and reproduced by the removal, or the application of a very small wire, and unlike the steam-engine which, when its action is made to cease, still continues with undiminished rapidity, to consume the fuel and the water; its energy, if interrupted even for a considerable time, does not become exhausted, but on the contrary, it acts when again put into motion with increased velocity and power. An oaken frame supports horizontally two magnets E and F, Fig. 1.

Fig. 1.



The soft iron bar A D is fixed in a strong frame of wood, of which B C is an an horizontal section. This frame resting on steel-knife edges swings perpendicularly between the magnets, and has fixed into its lower extremity an iron rod, connected with the reversing apparatus, with levers, a fly wheel, and any other required machinery. The apparatus for reversing the magnetic poles is light and simple, and may be easily adapted, with hardly an increase of weight to any number of magnets. Let A F, Fig. 2, be an axis upon which

Fig. 2.



the wires W W and W′ W′ crossing each other at O, are turned; these wires dip into small cups of mercury C, connected with C′ by the wire B B, and with the zinc Z of the calorimotor by the wire P, and into the cup C″ connected with C‴ by the wire E E and with the copper X of the calorimotor by the wire D—W W is connected with the cup of mercury V by the wire Q and W′ W′ is connected with the cup R, by K,—V and R, are connected respectively with the poles *n* and *s*, of an Electro-magnet M by the wires S and T. The wires Q and K rise in the cups V and R, but do not leave the mercury they contain. Let it be now supposed, as in the figure that the wires W W and W′ W′ dip into the cups C and C″, the current of electricity is thus traced. It flows from the copper X of the calorimotor along the wires D, and E E into C″, along K to R, and along T entering the magnet M at *s*, then passing from the other pole *n*, along S to V, along Q to C, along B B and P it reaches to Z, the zinc-plate of the calorimotor. Now let the wires W W and W′ W′ have turned a little on their axis A F, so that they shall dip respectively into C′ and C‴. The electricity now flows from the copper X along D to C‴, along W W, crossing the axis A F at O, along Q to V, along S and enters the magnet M at *n* before it entered at *s*, hence the current and by consequence the poles are reversed, the same movement of the axis with a very slight addition of wires, would evidently simultaneously reverse the poles of any number of magnets.

The exhibition of this model was received with sincere and reiterated applause, and many scientific men present expressed sanguine expectations of the value of the method in a practical point of view, all agreeing that it was the best attempt yet made of the many schemes that had been proposed for producing motive power by the electro-magnet.

Mr. M'Gauley then detailed with their results a series of experiments, which he had tried for the purpose of ascertaining the best means of constructing a powerful magnet, intending, very probably hereafter to pursue the subject on an extensive scale.

The Iron.—He tried with equal and similar helices, soft iron horse-shoe magnets of different dimensions, and of various shape. In order to determine the most convenient size for the bar of soft iron swinging between the magnets in his Electro-magnetic Machine; he tried keepers also of different dimensions; he thought it right to remark, that although in one case he found that with the same helix increasing the mass of iron, increased very greatly the lifting power, in another it diminished it; perhaps because of the too great disproportion between the helix and the bar, in neither case would the larger magnet lift small steel needles, though in both cases they lifted pieces of soft wire of equal size, probably because, although the sum of the excitement of the particles in a large mass of iron may be considerable with a small helix, the attraction of each individual particle may be inconsiderable; the intensity of the excitation may be trifling, just as when a small quantity of electricity is dispersed over a large coated surface.

The Battery.—He tried a number of batteries of various size with the same horse-shoe magnet; he tried the same battery and magnet with different fluids, and the same fluids in different proportions; the same magnet battery and charge interposing helices and magnets; the same magnet battery and charge, using various means of increasing their energy and prolonging its duration. He also examined the comparative effect of batteries of different construction.

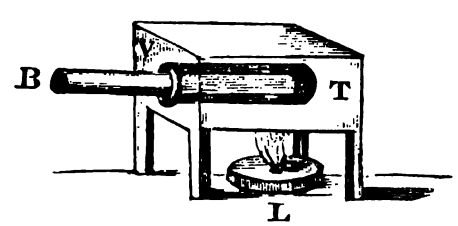
The Helix.—He formed similar horse-shoe magnets of soft iron with different helices, one a ribbon of copper;—five similar horse-shoe magnets with the same quantity of wire coiled into helices of various kinds, viz. one magnet had the wire coiled only on the extremities, and crossing directly from one pole to the other; the second had the wire coiled on the extremities, but connected by a spiral round the intermediate portion of the the magnet; the third had the wire divided equally, and each separate half placed as an helix on one end of the magnet; the fourth had the wire coiled equally over the entire magnet; the fifth had the wire divided into four equal parts, and each part coiled on one fourth of the magnet.

To discover in what proportion the power of the magnet increased with its size, he coiled an horse-shoe 7½ inches long and ½ square, with a certain quantity of wire, and another of the same length, but ¼ square with one fourth of the wire used with the former.

Mr. M'Gauley concluded his paper on Magnetism, by explaining what he believed he had

reason to suppose the real nature of Magnetism. He remarked the difficulties with which he had to contend, and the apparent rashness of differing in opinion from celebrated cultivators of science' but was encouraged when he remembered the nature and objects of the Association; besides, it were carrying our respect to an excess, were we to rest satisfied with what any one, however enlightened had accomplished, particularly in a matter of which the most learned know so little, and in which so many of our opinions must depend on a few facts, but imperfectly understood, and upon argumentation, but seldom, from the scantiness of our knowledge, as conclusive as we might desire. He hoped to found every thing he should advance upon experiment, and clear deduction. Magnetism, he conceived, does not necessarily derive its existence from, nor is necessarily accompanied by the circulation of *electric currents*, but is the *mere electrical excitation* of the *mass* or the *particles* of the magnetic body. 1. It does not necessarily arise from the circulation of electric currents, because it can begin to exist without them, can continue to exist without them, and because currents of sufficient quantity, velocity, and intensity, may be generated in conducting substances, without producing Magnetism. The truth of any of these he believed sufficient for his purpose. Again, Magnetism is mere electrical excitation, because by mere electrical excitement we can cause its existence; its various phenomena are just such as we should expect from electrical excitement, and because not currents but electricity at rest, is always found co-existent with it. 1. It can begin to exist without the circulation of electrical currents; he inserted into a copper vessel, V, Fig. 3, a glass tube T, whose interior ex-

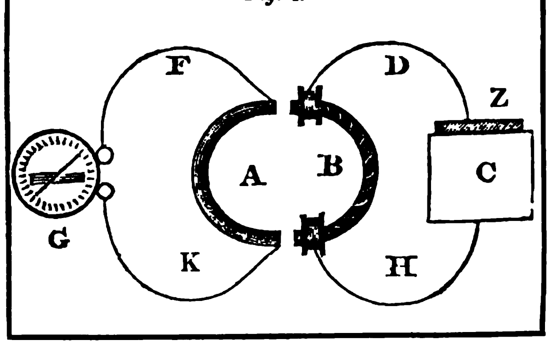
Fig. 3.



tremity was hermetically sealed; he placed in this tube, up to its centre, a cylindrical bar of soft iron, B, perfectly demagnetised, which nearly fitted it, filled the copper vessel with water, lighted under it a spirit lamp, L, and when the water boiled and the inserted bar was uniformly heated, he examined it, and found it sensibly magnetic; there was no current, nor could the effect be ascribed to thermo-electricity. The evaporation of the water produced electrical excitement on the bar by induction, and the electricity produced on the bar was of different intensity from that of the water since it was not restored to equilibrium, even by metallic contact. When he filled the copper vessel with 2 parts of sulphuric acid, 1 nitric acid, and 100 parts water, and introduced a small zinc plate, a considerable, but as far as he has yet examined it, a very anomalous magnetic effect was produced on the inserted bar. 2. Magnetism can continue to exist without the circulation of an electric current; having once magnetically excited an horse-shoe Electro-magnet, and placed on it a keeper, the generating current is no longer necessary; the keeper and the magnet act upon each other by induction, like the coatings of a leyden jar; the magnetic force is, indeed, diminished by the twofold induction, for the magnet did not induce on the keeper an excitement equal to its own, nor can the keeper in its turn retain on the magnet when battery communication has ceased, an excitement proportionably equal to what it had received. It cannot be said that the current circulates still around the magnet, although the generating current was interrupted, because the secondary current does not continue with the magnetism, for we acknowledge the existence of this current because it affects the galvanometer. Now it affects the galvanometer only at the *moment* when magnetisation or demagnetisation is produced, that is, only at the *moment* of *electrical excitation*, or *restoration to equilibrium;* hence it exists only at these times, and therefore, there is no reason to believe the constant circulation of electrical currents. 3. A current sufficient for magnetisation may exist without magnetism. He filled a glass tube with sulphuric acid, inserted a copper wire into each extremity, and made it part of a galvanic circuit: before the electricity entered the tube it deflected the needle of a galvanometer, but while in the tube it did not deflect it; this could not be ascribed to the diminution of quantity, velocity, or intensity; since after the electricity had passed the tube, and again entered the copper wire, it deflected the

needle, though less violently than before. 4. Electricity at rest, if we may use the expression, will produce Magnetism, as appeared from experiment, Fig. 3, 5, Magnetism, produces not the circulation of currents but electricity at rest. He placed pole to pole two horse-shoe magnets of soft iron A and B, Fig. 4, B had an helix connected

Fig. 4.

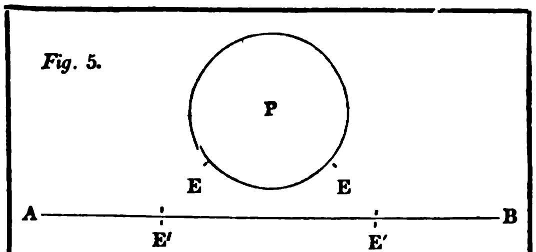


with a calorimotor Z C by D and H. A had its poles connected metallically by the wires F and K with the galvanometer G, but had no helix coiled around it. He magnetised B by means of its helix and battery, A became magnetic by induction at the moment of magnetisation, a current of electricity flowing directly from one of its poles to the other, and deflected the needle of a very delicate galvanometer he had constructed, 15°.

Received Theories.—Oersted's theory seems unfounded, since he supposes the existence of circulating electric currents, which the galvanometer demonstrates not to exist. Supplementary to this theory, some have supposed—to explain the peculiar properties of the conjunctive wire—a series of minute magnets arranged around it, but it does not appear with what foundation.

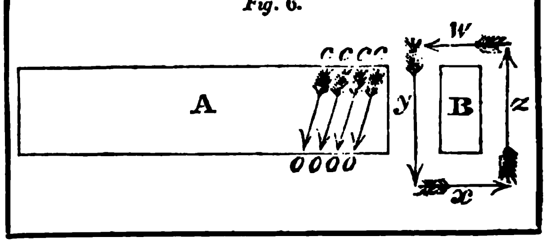
Ampere, also supposes currents, and to explain induction, conceives the generation of new currents around the particles to be magnetised, or a direction given to those already existing; but

Fig. 5.



this seems impossible, a *new current* cannot be generated, nor by consequence from the very nature of motion and rest, the direction of a pre-existing one be changed. For let us suppose a particle of iron P, Fig. 5, and a wire A B having an electrical current from A to B, let E E and E' E' be particles of electricity, or of electricity and matter mutually attracting each other; as there is a current in A B, there will be particles always at E' E', hence we may suppose particles fixed at these points; now E' E' will certainly have a tendency to draw the particles of opposite excitation E E from around or within the iron as near as possible to themselves, but none whatever to cause their circulation around the iron. Again, if to magnetise be to induce electric currents, we cannot conceive magnetic induction possible when we rub a magnetised bar upon one that is unmagnetised, and at right angles to it. Let A, Fig. 6,

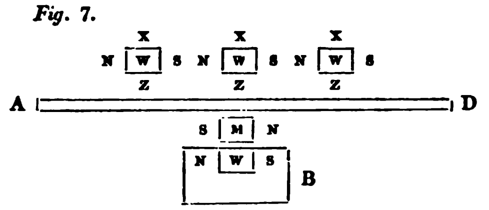
Fig. 6.



be a steel bar to be magnetised, and B, the horizontal section of a steel bar already magnetised, and at right angles to the former, when we superimpose B, and draw it from the centre to the extremity on A, we indeed magnetise A, but certainly do not cause the circulation of currents; for let the arrows *w*, *x*, *y*, and *z*, represent the currents already existing around B, and *co*, *co*, *co*, those to be created by magnetic induction in A. There will be a current *y* in the direction of *co*, but there will be an equal and counter-current *z* destructive of the former, *w* and *x* shall be wholly inefficient. If magnetism be mere electrical induction, we can explain its principal phenomena; thus ordinary electricity will furnish us with a resemblance of terrestrial induction. Electrify by induction with machine electricity an oblong conductor, suspend over it by a thread of silk another oblong conductor, separated at the centre into two parts by an insulating substance, let the poles of the smaller conductor be uninsulated, that they may be electrified by the in-

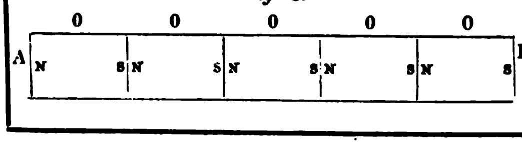
duction of the larger conductor beneath it, the two conductors will have a polarity, and represent the earth, and a terrestrially magnetised bar suspended over it, and the smaller conductor shall in every case arrange itself as the needle under the influence of the earth; but if the circulation of currents be necessary for magnetic induction, it is quite another matter. The currents of the earth may impinge against, or flow at either side of the intended magnet, but will have no tendency to cause a circulation round it. The fact of the direction of the current in the conjunctive wire having an influence on the species of polarity produced, he conceived of not very difficult explanation; he would not suppose the existence of minute magnets around the conjunctive wire as some had done, but a series of electric particles arranging themselves on the wire in the determinate way; he did not believe this a gratuitous supposition; for it is pretty certain that electricity is matter, and if the atomic theory be true, it cannot be doubted that its particles are of a certain fixed and determined shape. If these particles, by a species of condensation, arising from a large quantity being accumulated on a small space, were sufficiently condensed, they would tend to a kind of chrystallization,—opposite and corresponding sides attracting each other. Now magnetic electricity, from its acknowledged density, may easily be supposed to have its particles so near each other, as that their corresponding sides N. S. X. Z. W. and M, Fig. 7

Fig. 7.



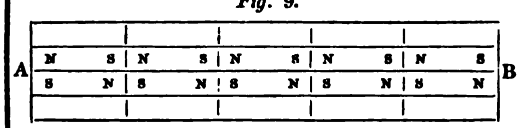
shall be mutually within the sphere of each other's attraction, as they flow along the conjunctive wire AD, and by induction shall arrange the particles of electricity in the bar of iron, of which B represents an horizontal section in a determined way, and thus cause a determinate polarity, so that all the particles of electricity in B of one denomination, will be turned uniform to the one pole, and of another denomination to the other pole. Two conjunctive wires having their currents in the same direction, shall have corresponding and attracting sides next each other, and shall therefore exhibit mutual attraction. In an Electro-magnet from experiment, Fig 4, it would appear that not the particles but the mass is electrified; with a permanent magnet, the case must be different, otherwise, if we divide it into parts, these parts would not have a distinct polarity. An Electro-magnet therefore should have its poles pretty near the extremity of the bar, a permanent magnet about one-sixth from the ends; for let AB, Fig. 8, be a permanent magnet, and let its

Fig. 8.



particles be 0. 0. 0. each particle has its poles N. and S. excited by induction, the centre particle has only the excitation of the original induction, the particle next to the centre has the same induction, but in addition, the induction of the centre particle, and thus with every succeeding particle, it is excited by the original induction, and that of the adjoining particle. If a be the Magnetism induced in each separate particle; b the difference for simplicity supposed constant; n the number of parcles, the sum of the series s, at either side of the centre particle $= \overline{a+\overline{n-1}.\,b}\,\frac{n}{2}$ and all the attractions may be supposed concentrated at a point distant from either extremity one-third of the space between the extremity and the centre, or one-sixth of the entire bar. A secondary current having the duration only of an indivisible moment *should* be found in the helix, this is evident whether a soft iron magnet have its excitation at the poles, or each particle being excited, and its sum of attraction be fixed in *effect* at one-sixth from the extremity. He deemed it easy to conceive how a mass of steel retains what he might call its magneto-electric excitement. Let A B, Fig. 9,

Fig. 9.



represent such a mass, we can suppose it made up of various strata of successive particles N S. N S. N S. these when the exciting cause is removed continue to act

on each other, and the adjoining strata by induction. This is found by experiment, since if we divide a magnetised steel bar, we may find its poles reversed at its various parts, perhaps the relative strength of a permanent magnet may depend on the comparative fewness of the neutralizing strata.

Electricity, galvanism, light, heat, the principles of gravitation, of chemical affinity, of the attraction of cohesion, aggregation, &c. may be one and the same, and as possibly a time may yet arrive, when it will be acknowledged that all the substances with which we are acquainted are modifications of the same element. Thus also the agencies by which matter is affected may hereafter be diminished in variety, Electricity may combine with other matter in determinate quantities, in one quantity and intensity it may be light; another quantity and lesser intensity, heat; less quantity and greater intensity, ordinary electricity; less intensity and greater quantity, galvanism; yet greater quantity and lesser intensity, magnetism, &c.; and whatever its quantity or intensity, it may be latent. The various states of electricity may not be separated by indivisible points, we may alter the quantity so as to produce caloric, or the intensity, so as to produce light, and yet we may not, of necessity, subvert chemical affinity, or the attraction of cohesion. Electricity may by its own action accumulate so as to alter its nature, as the quantity increases heat is first developed; further accumulation on the same space produces a species of augmented intensity, and light appears; further augmentation destroys the attraction of cohesion, separating the particles, of affinity, separating the elements, and if it were possible, yet further to increase the excitation, we might, perhaps, resolve even these into greater simplicity than has yet been attained. We can destroy magnetism by heat, because, from its low intensity it cannot pass through the particles of steel; but we superadd the electricity of caloric, the quantity and intensity are changed, and the magnetism and caloric flow away together and disappear; we magnetise steel by a blow, because compressing the particles, we alter affinity for electricity, some of their electricity passes into a free state, is arranged by the electricity of the earth, and the steel is magnetised, by repeating the blow we accumulate electricity on the external particles, and thus follow in succession caloric, light, &c. With reference to the mutual action of magnets, and of magnets and conductors, the magnetic rotations, &c. He considered hem easily explained, if we substitute for the mutual attractions of electrical currents, the attractions of electricities at rest, or of electricity and matter, modified by the laws which regulate the composition of forces.

The current of electricity formed by the rotation of a metallic disc between the poles of a magnet, he deemed strongly in his favour, since it is not so much the formation of a continued current, as the successive disturbance of the electrical equilibrium of successive portions of the disc. If the current would continue after the rotation of the disc were interrupted, the case were different. Ordinary electricity is restored to equilibrium in vacuo because of its superior tension, magnetism for a contrary reason is not restored; ordinary electricity from its tension is restored to equilibrium when its opposite states are in communication; when the poles of a magnet are in communication, in effect they are still insulated, besides there is in their regard an action similar to that of the mutual induction of the coatings of a leyden jar; for the keeper or any other intended metallic communication must be looked upon generally as one of the coatings of a jar rather than as a conductor.

If magaetism be mere electrical excitation, it is probable that a yet more economical way than the present, for producing powerful magnets, shall be discovered. It might be said that he only revived an an obsolete theory, but it will probably be found that this theory was never maintained really, plausibly, and by experiment. The great resemblance between magnetism and electricity was soon an object of remark, but the idea of their unity of nature was considered, the conception of those who perceiving resemblances between things, but imperfectly known, are too ready without sufficient reflection, to believe and assert their identity. It may be also said, that magnetism has been applied as a moving power, but he thought it would be found that the experiments made upon the subject, had attempted to apply magnetism at a loss of power too great ever to allow its adoption.

SUB-SECTION A.

MECHANICAL SCIENCE, APPLIED TO THE ARTS.

The great press of business in the Mechanical Section rendered it necessary to institute a Sub-Section for the Useful Arts, and the increasing interest felt in the subject of Civil Engineering, induced the Association to establish it as a permanent section of their body.

Mr. George Rennie was appointed President, and Dr. Lardner Vice President. The first meeting was held on Thursday, in the Law School, under the Library.

Mr. Eaton Hodgkinson reported to the Section, the result of certain experiments on impact, made in continuation of that valuable series of experiments, which he had communicated to the Association at the three previous meetings. They were to the following effect: 1. That cast iron beams being impinged upon by certain heavy masses, or balls of different kinds of metal, but of equal weights, were deflected through the same distances, whatever were the nature of the metals. 2. That the impinging masses rebounded after the stroke through the same distance, under similar conditions. 3. That the effect of the masses of different metals impinging upon an iron beam, is entirely independent of their elasticity, and is the same, as theory would give if these impinging masses were inelastic.

Mr. Hodgkinson gave also the result of some very curious experiments, on the fractures of wires in different states of tension; from which it resulted, that the wire best resisted fracture and impact when it was under the tension of a weight, which, being added to that upon it, equalled one-third of the weight necessary to break it.

Mr. Pritchard exhibited an achromatic microscope, made by him on the principles published in his works, in which the angular aperture of the Object Glasses exceeds any that have yet been produced. He briefly stated the advantages derived from it in the examination of the structure of bodies, especially the materials of textile fabrics—as flax, cotton, silk, &c. Mr. Ettrick read an account of a Mariner's Compass, which, by two adjustments, caused the cardinal points on the card to coincide with the corresponding points of the horizon, whereby the mariner is saved the trouble of allowing for the variation in steering, and the necessity of purchasing expensive variation plates. It was effected by securing the needle upon the card by moveable clamps, and adjusting such needle for the magnetic variation of Greenwich, with a contrivance for changing it in places having a different local variation.

Mr. Russell read a paper on the solids of least resistance, with reference to the construction of steam vessels, and detailed several experiments to prove, that the object would be best attained by giving a parabolic form to the prow. Some doubts were expressed, as to the scientific principles by which this theory was supported, by Professor Moseley, and Dr. Lardner.

Mr. Taylor, the treasurer of the British Association, made a communication respecting the monthly reports of the *duty* of steam-engines, employed in draining the mines of Cornwall. He observed, that he had found at this and other meetings of the Association, considerable interest to be expressed, with regard to this mode of recording the actual effect, produced by the consumption of a given quantity of fuel, and recommended the subject to the notice of engineers in general. These reports gave the means of comparing one engine with another in the district; they also afforded an historical view of the progress of improvement in this important machine; and they had, as Mr. Taylor believed, contributed largely to that improvement, by the emulation and attention excited by them, in the persons who had charge of constructing and managing the engines. Mr. Taylor stated, that the work done in the best engines now employed in Cornwall, by the consumption of one bushel of coals, required ten or twelve years ago the consumption of two bushels; that during the period of Bolton and Watt's patent, four bushels were consumed to do the same work; and that in the earlier stages of the employment of steam-power, the quantity of coal used was 16 bushels. He said, that the steam-engines now at work for draining the mines in Cornwall, were in equal in power to at least 44,000 horses. He testified to the accuracy of the duty reports, declaring that he had compared them with the account books kept at the different establishments, and found that the resnlts of both coincided.

Dr. Lardner then addressed the Section on the subject of railroads; but the matter having been gone into fully next day by the learned Doctor and Mr. Vignolles, we consider a report of this day's proceedings unnecessary.

Mr. Grubb made some observations on an improved method of mounting an equatorial instrument adopted by Edward J. Cooper, Esq. M. P. of Markree Castle, county Sligo.

Mr. Cooper bore testimony to the excellence of the instrument, as also to the talent and perseverance of Mr. Grubb in his scientific improvements and inventions.

[For Diagram of Instrument, see Appendix.]

SECTION B.—CHEMISTRY AND MINERALOGY.

Doctor APJOHN read a paper on the specific heats of the permanently elastic fluids.

In the introductory part of this communication, a rapid sketch was given of the methods of experimenting employed, and the results obtained by those who had preceded him in this enquiry; attention was called to the difference between the specific heat of a gas under a constant volume and a constant elasticity, and a brief explanation was given of the ingenious means by which Dulang was enabled to arrive at a knowledge of the ratio which subsists between the capacities of the same gas under these two distinct conditions. The numbers adopted by this philosopher were then shewn to be at least in part deduced from an hypothesis which may not be true, namely, that all gases, in undergoing a given compression, evolve the same amount of caloric; and the conclusion thence drawn, that his results could not, any more than those of De La Roche and Berard, be considered as finally disposing of the question. Doctor Apjohn then proceeded to explain the principle of an entirely new method which he was enabled to apply to the investigation of the difficult problem under consideration, in consequence of having recently been fortunate enough to arrive at a formula which expresses with extreme and unexpected precision, the relations subsisting between the indications of the wet-bulb hygrometer and the corresponding dew-points. This formula being equally true of all the gases, suggests a ready method of comparing their specific heats; for these being factors in the formula, they may, as was shewn in the paper, be represented, when the barometer stands at 30, nd that the gases are perfectly dry, by a fraction whose numerator is the product of the tension of aqueous vapour by its caloric of elasticity, both estimated at the temperature shewn by the moist thermometer, and whose denominator is forty-eight times the depression of temperature indicated by the same instrument. The experimental means by which he arrived at these necessary data were next described, the manner of applying to the results of experiment certain necessary corrections explained, and the final results then stated. These researches tend to establish the important law, that, with the exception of hydrogen, all gases have, under equal volumes, specific heats proportional to their specific gravities; or, in other words, that under the same weight all have the same capacity for caloric.

The author, in conclusion, stated that he advanced with diffidence, conclusions of such generality and importance, differing materially as they do from the experimental determinations of De La Roche and Berard, and directly opposed as they are to the simple law deduced first by Haycraft, and subsequently by Marcet and De La Rive. His experiments, however, were so satisfactory and consistent, that he felt he should not hesitate to submit the legitimate inferences which flow from them to the British Association, being satisfied that if they did not contribute to the solution, they would at least serve to show the necessity for the reinvestigation of a question of the highest theoretical and practical interest.

Dr. DALTON next brought forward his views of the nature of the Atomic Theory, which appeared to excite great interest, as, in addition to those who usually attended this Section, we noticed very many of the leading members of the Physical, Statistical, and other Sections present. Dr. Dalton had prepared a lithographic plan of his arrangement, and showed how the molecules of bodies may be considered grouped so as to represent compound atoms, (for which see Appendix.) He stated that he considered this method as the only one representing nature, and that if the British Association sanctioned the adoption of the notation of Berzelius, as was desired by many Irish and British chemists, it would virtually have placed an extinguisher upon itself.

Professor WHEWELL stated, that reserving all due respect to the opinions of Dr. Dalton, to whom, as the discoverer of the atomic theory, the admiration of all chemists for all ages must be necessarily awarded, yet he should declare, that he considered it impossible, in the present state of science, to rest satisfied with the arrangement of Dr. Dalton. The chemists of all other nations had fallen into the views of Berzelius. The right, and, what was more, the power, of priority was vested in Berzelius, and the only effect of our keeping back would be, to throw us behind science. Moreover, Dr. Dalton's method supposes a theory, Berzelius only states a fact. The notation of the Swedish chemist shows that such and so many atoms are present. Dr. Dalton's, on the other hand, attempts to show their *method* of molecular arrangement, of which we have no positive knowledge whatsoever.

Dr. KANE was glad to find that the question of

chemical notation had been brought before the Section in such a manner, and would venture but few observations. The necessity for notation in chemistry was now universally admitted, and the only question lay between the systems of Berzelius and of Dalton. To represent the existing state of chemical science we must have formulæ of two kinds, one representing merely the result of analysis, giving the relative number and nature of the atoms composing a body, the second exhibiting the actual number and the mode of grouping of these atoms. These are the empirical and the rational formulæ, the former representing absolute fact, the latter particular theory. Now he (Dr. Kane) objected to Dr. Dalton's views that they necessarily involved his own theoretical ideas, as in the instances of alcohol and ether of acetic acid, pyroacetic spirit and pyroxylic spirit, the compounds of phosphorus, &c. Whilst the notation of Berzelius being merely letters, capable of indefinite combination, can be used by all chemists, each to express his own peculiar views, which thus become universally intelligible.

Mr. Babbage rose to state, that the object of chemists in this discussion was not to impugn the truth of the great law of nature discovered by Dr. Dalton, but to consider the most fitting language in which to clothe it, so that it should be understood and appreciated by all. The language employed by Dr. Dalton, although adopted to explain the simpler combinations of substances, became quite insufficient when much more extended relations were to be discussed. There must, therefore, arrive a period at which it must be given up, and it would be highly inexpedient to have two systems of signs for one object. He was glad to find that the tables of chemical constants, that Professor Johnston had been requested last year to draw up, had been executed in a manner so creditable to that gentleman and to the Association; and he hailed their appearance as the first of the constants of nature and art, in the publication of which he himself took such interest.

Professor Johnston stated that he was happy that the manner in which he had executed that task had proved satisfactory to the Section. He would only make one remark on the subject of notation, but that one he considered of importance. The method of symbols proposed by Dr. Dalton might, perhaps, apply to the simple cases of combination that had been selected by that philosopher as examples, but when they come to be applied to groups consisting of 40, or 60, or 100 molecules, how could the eye recognize at a glance their method of arrangement. There might be a rivalry between the systems of notation in cases of binary or ternary combination, but when we come to embody all our existing knowledge in formulæ, the system of Berzelius must be made use of, because it is the only one that can *possibly* be applied.

SECTION C.—GEOLOGY AND GEOGRAPHY.

The proceedings of this day commenced with a paper by Mr. Williams, in which he describes some vegetable organic remains found in Shale, occurring between beds of culm. These he had examined with the view of ascertaining whether any distinction in geological age could be drawn between the coal of Devonshire and that of South Wales, by the character of the vegetation of the epoch of formation. His examination proved that such could not be done; and as he considers the coal of Devonshire decidedly transition, Mr. De la Beche's views of the similarity of fossil plants in the transition and true coal series, are, in his opinion, confirmed.

Professor Sedgwick referred to the experiment of Mr. Lindley, as showing that only a very small number of plants were capable of resisting the destructive agency of water, and consequently, that a large, perhaps a characteristic, portion of the vegetation of particular epochs may have passed entirely away. And further observed, that alterations in the ocean may have materially affected the beings existing in it, whilst those living cotemporaneously on the land, might not have experienced a corresponding change.

Mr. Murchison stated that he had at first hesitated to assent to Mr. De la Beche's statement, considering that it required more full elucidation and proof, and expressed his obligation to Mr. Williams, for throwing additional light upon the subject.

M. Agassiz presented the 4th and 5th livraisons of his great work on fossil fishes, and stated, that by the great addition of 300 species, which had been obtained from the cabinets of these countries, the total number had been raised to

about 900. He then advanced some general views on the conclusions to be drawn from the geological distribution of fishes, and explained the precision in determining epochs which their higher state of organization and consequent susceptibility to external influences afforded. It is not to be supposed, said Mr. Agassiz, that fishes living in one set of strata, could have lived in another; for, if so, why are not some vestiges of them found? On the contrary, the fishes of the carboniferous period were different from those of the lias; the fishes of the lias are different from those of the oolite; and those of the oolite from the fishes of the chalk; and as it must be presumed that fishes living together so co-exist from the necessity of their organization, and its adaptation to attendant circumstances, it must also be presumed that their disappearance was the result of a change in the conditions of the earth's surface. In estimating the effects of such changes, it is necessary, M. Agassiz observed, to distinguish between general phenomena affecting, as it were, the laws of nature, and those of a mere local character, such as volcanic eruptions. The local phenomena may indeed have been similar to those of the present time, but the elevations of mountain chains are evidences of a more general class of phenomena, which have affected organic life, constituting thereby the various zoological epochs which may be traced in the earth's strata. It was in such periods of violence and change, that the beds of any one system were deposited, the animals co-existing at the time being according to the more or less susceptible nature of their organization, more or less completely annihilated; and it was in the tranquillity which followed, that new being were formed and lived to tenant in like manner the strata of another system, which should result from another epoch of disturbance. M. Agassiz produced, as an example of sudden destruction, a drawing of fossil fishes crowded together in a very confused manner, such as could only have arisen from an instantaneous catastrophe, arresting them as it were in a moment. M. Agassiz then, at the request of Professor Sedgwick, explained those characters, such as the position of the fins, the arrangement and size of the scales, &c. by which the fishes of different geological eras may be distinguished, referring especially to those of the old and new red sandstones, and thus concluded a statement full of the highest interest, and affording another bright example of the mutual advantage obtained by combining together the philosophical speculations of the zoologist and geologist.

At the conclusion of his address, the ready intelligence of M. Agassiz was put to the test by the production of some fine specimens of Fossil Fish from the new red sandstone above the coal, in the county of Tyrone, placed on the Table of the Section by Captain Portlock. These M. Agassiz examined and stated to be a new species of the genus palæoniscus, which he named *palæoniscus catopterus*, the distinguishing character being the position of the dorsal and anal fins, which are nearer to the tail than in other species of the genus. He was asked if he could (without seeing this) describe the different species of fishes found in that strata, in the new red sandstone, and in the carboniferous beds between them. He *instanter* drew the three kinds with chalk upon a board, and it was found that he had accurately delineated the example so unexpectedly brought forward. (Great admiration followed this display of talent and information.)

The following extract* from M. Agassiz's interesting work, recently published, relative to a "new classification of fishes, and on the geological distribution of fossil fishes," will give the reader an idea of that learned Professor's views on the subject.

He begins by observing that the state of the science of Ichthyology had obliged him to undertake an examination of recent fishes for the sake of comparing them with the fossil species, and in doing so that he had arrived at a classification in general, differing considerably from the various arrangements previously adopted by naturalists. One of the essential characters of fishes is, to have their skin covered with scales of a peculiar form and structure. This covering, which protects the animal without, is in direct relation with its internal organisation, and Dr. Agassiz has found that by an attentive examination of the scales, fishes may be divided into more natural orders than had hitherto been adopted. In this manner he has established four orders which bear some relation to the divisions of Artedi and Cuvier; but one of which, hitherto completely misunderstood, is almost exclusively composed of genera, whose species are found in only the most ancient strata in the crust of our globe. These four orders are, the *Placoïdians*, which comprehend the cartilaginous fishes of Cuvier, with the exception of the sturgeon; the *Ganoïdians*, which comprehend above fifty extinct genera, and to which we must

* For the translation we are indebted to the pages of the *Literary Gazette*.

refer the *Plectognaths*, *Syngnaths*, and *Acipensers*; thirdly, the *Ctenoïdians*, which are the *Acanthopterygians* of Cuvier and Artedi, with the exception, however, of those which have smooth scales, and with the addition of the *Pleuronectes*. Lastly, the *Cycloïdians*, which are principally *Malacopterygians*, but which comprehend, besides, all those families excluded from the *Acanthopterygians* of Cuvier, and from which we must take the *Pleuronectes* placed among the *Ctenoïdians*. If we estimate the number of fishes now known to amount to about eight thousand species, we may state that more than three-fourths of this number belong to two only of the above-mentioned orders; namely, the *Cycloïdians* and *Ctenoïdians*, whose presence has not yet been discovered in the formations inferior to the chalk. The other fourth part of living species is referable to the orders *Placoïdians* and *Ganoïdians*, which are now far from numerous, but which existed during the whole period which elapsed since the earth began to be inhabited, to the time when the animals of the greensand lived. These remarkable conclusions, to which M. Agassiz had come from the study of more than six hundred fossils on the continent, have been corroborated by the inspection of more than two hundred and fifty new species found in English collections. The author next observes, that in fishes more considerable differences may be remarked within narrow geological limits than among inferior animals. We do not see in the class of fishes the same genera, nor even the same families, pervading the whole series of formations as take place among zoophites and testacea. On the contrary, from one formation to another, this class is represented by very different genera, referable to families which soon become extinct, as if the complicated structure of a superior organisation could not be long perpetuated without important modifications; or rather, as if animal life tended to a more rapid diversification in the superior orders of the animal kingdom, during equal periods of time, than in its lower grades. With respect to this, it is with fishes nearly as with mammifers and reptiles, whose species, for the most part but little extended, belong at a short distance in the vertical series to different genera, without passing insensibly from one formation to another, as is generally admitted to be the case with certain shells. One of the most interesting facts which M. Agassiz has observed is, that he does not know a single species of fossil fish which is found successively in two formations, whilst he is acquainted with a great number which have a very considerable horizontal extent. But the class of fish presents besides to zoological geology the immense advantage of traversing all formations. Thus they afford us the only example of a great division of vertebrated animals, in which we may follow all the changes experienced in their organisation during the greatest lapse of time of which we possess any relative measure. The fish of the tertiary formations approach nearest to the recent fish, yet hitherto the author has not found a single species which he considers perfectly identical with those of our seas, except the little fish which is found in Greenland in geodes of clay, and whose geological age is unknown to him. The species of the crag of Norfolk, the superior subapennine formation, and the molasse, are related for the most part to genera now common in tropical seas; such are the *Platax*, the large *Carcharias*, the *Myliobates*, with large palatal plates, and others. In the inferior tertiary formations, the London clay, the calcaire grossier of Paris, and at Monte Bolca, a third at least of the species belong to genera which exist no longer. The chalk has more than two-thirds of its species referable to genera which have now entirely disappeared. In it we already see even some of those singular forms which prevail in the Jurassic series. But as a whole, the fishes of the chalk recal more forcibly the general character of the tertiary fishes than that of the species of the Jurassic series. If we paid attention only to fossil fish in the grouping of geological formations on a large scale, the author thinks it would be more natural to associate the cretaceous with the tertiary strata than to place the former among the secondary groups. Below the chalk there is not a single genus which contains recent species, and even those of the chalk which have them, contain a much greater proportion of species which are only known as fossil. The oolitic series, to the lias inclusive, forms a very natural and well-defined group, in which also must be included the *Wealden*, in which M. Agassiz states he has not found a single species referable even to the genera of the chalk. Henceforth, the two orders which prevail in the present creation are found no more; whilst those which are in a small minority in our days appear suddenly in great numbers. Of the *Ganoïdians*, those genera which have a symmetrical caudal fin are found here, and among the *Placoïdians* those above all predominate which have their teeth furrowed on both the external and internal surface, and have large thorny rays: for it is now certain that those great rays which have been called *Ichthyodorulites* belong neither to *Silures* nor to *Balistæ*, but are the rays of the dorsal fin of the great *Squaloids*, whose teeth are found in the same strata. On leaving the lias to come to the inferior formations, we observe a great difference in the form of the posterior extremity of the body in the *Ganoïdians*. All have their vertebral column prolonged at its extremity into a single lobe, which reaches to the end of the caudal fin, and this peculiarity extends even to the most ancient fishes. Another observation worthy of attention is, that we do not find fishes decidedly carnivorous before the carboniferous series; that is to say, fish provided with large conical and pointed teeth. The other fish of the secondary series below the chalk appear to have been omnivorous, their teeth being either rounded, or in obtuse cones, or like a brush. The discovery of coprolites containing very perfect scales of fish which had been eaten, permits us to recognise the organised beings which formed the food of many ancient fish; even the intestines, and in some fossil fish of the chalk the whole stomach, are preserved, with its different membranes. In a great number of fish from Sheppey, the chalk, and the oolite series, the capsule of the bulb of the eye is still uninjured; and in many species from Monte Bolca, Solenhofen, and the lias, we see distinctly all the little blades which form the branchiæ. It is in the series of deposits below the lias that we begin to find the largest of those enormous sauroid fish whose osteology recals, in many respects, the skeletons of saurians, both by the closer sutures of the bones of the skull, their large conical teeth, striated longitudinally, and the manner in which the spinous processes are articulated with the body of the vertebræ and the ribs at the extremity of the spinous processes. The small number of fish yet known in the transition formations does not permit the author to assign to them a peculiar character, nor has he discovered in the fossil fish of strata below the greensand any differences corresponding with those now observed between marine and freshwater fish, so that he cannot, on ichthyological data, decide on the freshwater or marine origin of the ancient groups.

Mr. Murchison remarked, that acting on the old impression, that fossils were scarcely to be expected in the old red sandstone, he had missed for a time many of great geological value. He had subsequently found fish in the old red sandstone—those of England corresponding exactly with those of Scotland; and he therefore fully agreed with M. Agassiz, that distinct fishes characterized distinct geological strata. Mr. Murchison then, in a very feeling manner, dwelt on the important consequences which had attended the efforts of the British Association to promote and support the researches of M. Agassiz, which had already earned for that distinguished naturalist the united applause of all lovers of science, and as a just tribute of respect, the Wollaston Medal. Mr. Murchison considered that some part of this honour was necessarily reflected on the body which had supported him, and trusted that a similar zeal for science would lead to a renewal of the same efforts to advance its progress.

Dr. Traill being aware of the limited time remaining on that day, gave only a sketch of his geological enquiries in Spain, confining himself to a few only of the more striking peculiarities. He stated that it was an error to suppose all the mountain chains of Spain branches of the Pyrenees, from which they are in many cases completely separated. The variety of climate, and circumstances produced by the union of these mountains with the elevated table lands of New Castile, which is two thousand feet, and of Arragon, which is two thousand five hundred feet above the sea, had very peculiar effects on the flora of the country. Dr. Traill pointed out the identity of character which existed between the granites and schists of Spain and England, and proceeded to the newer strata; described the brine springs and salt lakes of Andalusia, and the deposit of salt which forms part of the base of the plain of Grenada. He also showed that lias and true chalk, with layers of flint, occur in the south of Spain, and confirmed the statements by Colonel Silvertop, of the tertiary deposits of Spain. Dr. Traill further observed, that bones are found in the fissures of other hills in Spain besides that of Gibraltar.

The business of the Section, this day, terminated in a paper by Mr. Smith, of Jordanhill, on a fossil forest near Glasgow. It is seen at the aqueduct of the Kelvine River, and consists of a number of trees standing in an upright position, and throwing out roots in all directions, just as if they had grown on the spot. They rest on nearly horizontal strata of sand-stone, at the bottom of a quarry, and terminate upwards at the height of a few feet, as if cut right across. The trees are all dicotyledonous, and some of them are so near one another, that it is difficult to conceive how they grew. The quarry is covered by diluvium, many rolled fragments of which must have come from the N.W., thus confirming what was shown at a former meeting by Mr. Bryce, respecting the diluvial currents of the north of Ireland.

Professor Sedgwick explained, that as all the trees were most probably of the fir tribe, they may have been nearly bare of branches, and have grown close together.

Mr. J. S. Menteith observed, that the celebrated Craigleith fossil tree lay across the layers of freestone, and was not vertical, as these trees.

Mr. Murchison has explained, in a previous publication, the cause of the trees being cut off at a constant height, by presuming that the gradual accumulation of sand around their trunks has occasioned decay and death.

The Section adjourned at an early hour, and proceeded to Killiney, there to examine the junctions of the granite and mica schist. Other occupations preventing Mr. Griffith from attending, Mr. Murchison, as Vice-President of the Section, expressed his opinion that the evidence of the veins of granite cutting through the schist and entangling portions of it, were quite as clear and unequivocal as in any of the celebrated Scottish cases. MM. de Montalimbert and De Verneuil of Paris, M. Agassiz, Mr. Egerton V. Harcourt, Mr. G. Wood, Dr. Lloyd, Captain Portlock, Mr. Torrie, and many others, seemed much satisfied with the views of Mr. Murchison. These granite veins have been described by the Rev. G. Sidney Smith, in the Journal of the Geological Society of Dublin.

SECTION D.—ZOOLOGY AND BOTANY.

Mr. Sturge, of Birmingham, read a highly interesting paper on the recent discovery of a Toad in a sandstone rock in Park Gardens, Coventry, during the excavation of the hill for the railway.

Portions of the rock having been separated, a number of them were thrown into a waggon, and the one containing the animal having fallen off, was separated by the fall into two portions; in one of these John Hart and Thomas Tilly, two of the workmen, discovered it, and with a kick of the foot dislodged it from the cavity alive. The other workmen were then called to witness the fact, and the animal and the two fragments of the stone were taken home by the engineer, who again introduced the animal, and closed them up. In this manner, with some occasional disturbance, it lived for a period of four days. The sandstone was tolerably porous, but quite free from damp from which the animal could draw nutriment, or any fissure by which it could be supplied with air for respiration. A very interesting conversation here took place as to the state of vitality in which the animal existed previously to its discovery. It was maintained by one of the section, that it must have been hermetically sealed up in a state of torpor, otherwise the waste consequent upon respiration must, in course of time, have led to its extinction; and in this opinion he appeared to be joined by almost all present. It was stated by Mr. Sturge, in reply to a question, that on its first enlargement, the animal appeared to suffer considerable uneasiness and difficulty of breathing; but he was unable to say whether the concussion experienced by the splitting of the rock could have led to its resuscitation, the two workmen already mentioned being the only persons present at the time. Mr. S. informed the section, that he had written to England for the two portions of stone containing the cavity, for exhibition here.

Mr. Mackay, Curator of the College Botanic Garden, stated, that while in the neighbourhood of Killarney, he was informed that a species of "black frog" existed in considerable numbers there; supposing he was about to witness a new variety of the species, he proceeded to open an old wall, where he found several full-grown toads. This fact, opposed as it is to the general disbelief of their existence in Ireland, occasioned a considerable sensation.

A member stated that there exist two distinct varieties of the toad in England; one, so active as to move about even with rapidity and the ordinary animal known by that name. The former variety is distinguished from the latter by a yellow line down the back, and two spots on the anterior part of the body.

Dr. Barry read a paper on the dark colour assumed by the sky in the higher regions of the atmosphere, and instanced his own observations on ascending Mont Blanc. At a particular elevation, when surrounded by fields of snow, the sky deepened in tinge, and became dark violet: this he endeavoured to prove to be the effect of the influence of rays from the snow, received upon the retina of the eye. In order to shut out this influence, he stretched himself on his back, and, giving the eye a short rest, the dark colour disappeared, and various shades, more or less developed as he shut out or admitted those rays, were admitted to his vision. These various shades, and the corresponding influences which gave rise to them, he very ingeniously reduced to a scale, and illustrated them by comparison with the various tints afforded in the decomposition of light by the agency of the prism.

Dr. Jacob observed that the optic nerve of the eye is in many individuals insensible to certain colours, and instanced a red book lying on the table, which, from a peculiar construction of the eye, he stated would appear green to an individual with whom he was acquainted.

Mr. Mackay submitted a polished piece of Irish yew, which furnished a striking instance of the tardiness of growth and great age attained by this species. The particulars were communicated by Mr. Charles W. Hamilton, Honorary Secretary of the Horticultural Society of Ireland. The number of annual layers or circles in this specimen proved its age to have exceeded five hundred and forty-five years. Mr. Mackay adduced several arguments to prove, that this tree is indigenous to Ireland, and at present consists of two species—the spreading or common yew, and the upright or Florincourt variety. He stated also, that many fine specimens of the species might be seen at Comber, and near Antrim, and at Mr. Bourne's, of Terenure, near this city.

A member of the section mentioned a yew tree, the property of Mr. Tennant, of Bangor, Co. Down, of which at present a portion only remains; forty years ago, however, it was measured by a gentleman, who counted the layers in a given quantity, and making the proper allowance for the difference in breadth between the central and more superficial circles, pronounced its age to be coeval with (if it did not exceed) the Christian era. Several hybrid varieties of the tree were reported to the section by members.

Dr. Litton, Professor of Botany, informed the

section that the tradition of the great yew at Muckross, in Killarney, exactly corresponded with the number of years indicated by its layers.

Mr. Mackay read a paper on Phœnogamous Plants and Ferns indigenous to Ireland, which are not found in England or Scotland.

Erica mediterranea, E. B. Sup.—First found on Erris-beg mountain, near Roundstone, Cunnemara, Oct. 1829. It has since been observed by Mr. Wynne, jun. of Hazlewood, and other gentlemen in the wild district of Erris. It is a distinct variety from the plant cultivated in gardens under the above name.

Menziesia Polifolia—Plentiful throughout Cunnemara and the mountainous districts of Mayo. A beautiful variety with white flowers is occasionally met with, which is now highly esteemed in collections.

Arenaria ciliata—On the Limestone rocks of Ben Bulben and other mountains of Sligo, where it was first found in October 1806.

Arabis ciliata—On the sea shore near Renvylle, Cunnemara, and other places along the coast, in Oct. 1806. It has subsequently been found by Mr. James Drummond, on the western coast of Kerry.

Saxifraga umbrosa, E.B.—Woods at Glengariff, near Bantry.

β. *Hooker*—On the summit of Curan Tuthol, the highest of Magillycuddy's Reeks, and on the Galway, Mayo, Sligo, and Donegal mountains.

Dr. Barker has also observed it growing plentifully on the Waterford mountains.

γ. *Hooker. Robertsonia serrata*, *Haworth.* Gap of Dunloe, 1805, and there only. A very distinct variety, or perhaps a distinct species.

Saxifraga Geum, Linn. and Hooker—Leaves hairy on both sides. On rocks by the rivulet below Turk waterfall, in Oct. 1805.

β. *Hooker*. E. Bot. t. 1561—On the cliffs of Mangerton, Priest's Leap, and other Mountains in Kerry and Cork, abundant.

γ. *Hooker*, *Robertsonia polita*, *Haworth*, Conner Cliffs, near Dingle.

δ. *Hooker*, *Saxifraga elegans*, Mackay MSS.—On a rock on the summit of Turk mountain, Killarney, in 1805.

ε. *Hooker*, *S. gracilis*, Mackay MSS. Conner Cliffs, 1805.

Saxifraga hirsuta, Linn.—Gap of Dunloe, 1805.

Saxifraga lævis, Mackay MSS. summit of Brandon, county of Kerry, 1805.

Saxifraga incurvifolia, Don. summit of Brandon with the last

Saxifraga hirta, E. Bot. t. 2291, figure excellent. On rocks in mountain streams, on Magillycuddy's Reeks, County of Kerry, and Galtymore, County of Tipperary, in 1805-6.

Arbutus unedo—Plentiful at Mucruss and other places near Killarney, and at Glengariff, near Bantry. Mr. Drummond found it in elevated situations in the wild district of Ivragh, and hence supposes it to be truly indigenous.

Rosa hibernica, E. Bot. t. 2196—Counties of Down and Derry, Mr. Templeton. Mr. D. Moore has lately found it in the latter county in a truly wild situation. It grows in hedges on the shore below Belfast.

Rosa Sabina—A new variety of this species was found in the County of Derry, by Mr. Moore Botanist to the Ordnance Survey, in the autumn of 1834.

Hypericum Calycinum—Mucruss woods, Killarney, 1805, perhaps introduced. The Rev. Dr. Hinks, who subsequently found it near Cork, in company with Mr. J. Drummond, and sent it to the late Sir J. Smith, now thinks that it must have escaped from a garden in the situation where he found it.

Ulex Strictus—This upright variety of the Ulex Europæus was found in the Marquis of Londonderry's park, County of Down, about thirty years ago, by Mr. John White; it seldom flowers, but is readily propagated by cuttings, and makes a neat hedge for sheltering tender plants.

Neottia gemmipara, Smith, Engl. Fl. v. iv. p. 36.—This rare orchideous plant was found by Mr. J. Drummond, sparingly in marshes near Bantry Bay, about twenty years ago, but no one has since found it.

Taxus Hibernica—This very distinct variety of yew, if not a distinct species, is found apparently wild in the woods of Florencecourt, the seat of the Earl of Enniskillen. Fine specimens in a cultivated state are to be seen at Comber, and near to the town of Armagh.

Equisetum Drummondii, Hooker, Br. Fl. ed. 2, p.—First found by Mr. Thomas Drummond, on a moist bank, near Cave-hill, Belfast, where I have since gathered it in company with Mr. Wm. Thompson, and Mr. Francis Whitla.

Trichomanes brevisetum, Eng. Bot. t. 1417—(Hymenophyllum alatum)—First found in fructification on a moist bank, near the Waterfall, between Turk and Mangerton Mountains, Killarney, in October 1805, and subsequently in the same state by

John Nuttall, Esq. of Tittour, County of Wicklow, in Hermitage Glen in the same county. Barren fronds of this interesting fern had been previously found in England.

Note.—*Ammi Majus*, which I inserted in my Catalogue of Irish plants, was found at Portmarnock, in 1821, by Mr. E. Murphy and myself, but as the ground has since, been ploughed up, and the plant destroyed, it cannot now have a place in our Flora.

Clypeola Jonthlaspi, Mackay's Cat. *Alyssum minimum*, which I have, since publishing it, found it to be, is still to be found very sparingly on a sandy ditch bank at Portmarnock, but has, as well as the last, been probably introduced.

A conversation on the locality of plants took place, involving some interesting questions, by which the various physical states of the atmosphere are indicated in different portions of the empire, and the susceptibilities of certain species and families of plants which inhabit them.

The Rev. CHARLES MAYNE communicated a method by which the spines of the Echinus, or Sea Urchin, may be preserved; this discovery was altogether accidental. In order to neutralise the offensive effluvia of the animal, he immersed the specimen in a weak solution of chloride of lime, which he found had not only the desired effect, but also that of permanently fixing the spines. He also exhibited several specimens preserved by this method.

The Section adjourned at an early hour.

Several of the members proceeded on a botanical excursion to Killiney, accompanied by Mr. Mackay.

SECTION E.—ANATOMY AND MEDICINE.

At the opening of the section, Mr. CARMICHAEL made some observations in reply to a paper read by Dr. HOUSTON the preceding day, respecting the hydatid or parasitical nature of cancer, Mr. C. maintaining that such was his opinion on the subject, in opposition to that of Dr. Houston, who had stated that hydatids and other such parasites die away in the flesh, and do not terminate in the production of malignant diseases.

Dr. HOUSTON felt gratified by the attention which his communication had excited, but would not enter further into the subject, as it was one which did not admit of being settled by extempore discussion.

A report was read by the Secretary from Dr. ROUPEL, as requested at the meeting in Edinburgh, 'on the action of certain poisons on the animal system.' The report contained the details of several experiments on animals, also delineations of the effects produced on the stomach and other parts by their deleterious influence. Having detailed several experiments, the report concluded by stating, that any attempts at explaining the effects of the experiments must, in the present state of animal chemistry, be merely conjectural. How far poisonous substances prove irritant by their chemical agency, or by exciting in certain parts the peculiar susceptibility to inflammatory action, it is not easy to determine; but it must be admitted, that something more than mere contact is required in those cases, where irritants applied to the surface, or thrown into the veins, provoke inflammation of the intestinal canal. Whether it be, that the system is on its guard against those substances which tend to increase the coagulation of blood, must be made a matter for future investigation; but certain it is, that substances endowed with this property, seem to have a great tendency to excite the inflammatory condition. It is a curious fact also, as connected with this point, that the coagulation of the blood becomes diminished under such circumstances; or in other words, that coagulation goes on more slowly in an inflamed state of the blood.

The thanks of the meeting were voted to Dr. Roupel, for the zeal, punctuality, and skill with which he had executed the undertaking.

Professor ALISON, of Edinburgh, read a most interesting and satisfactory paper on the state of the arteries leading to inflamed parts. During the continuance of inflammation, the arterial capillaries were in a state of relaxation and distension, and unable to transmit forwards the blood sent to them; and not only the capillaries, but also the larger arteries leading to them, were thus affected, having lost a portion of their contractile power, usually denominated tonicity. The latter position the learned professor endeavoured to prove by direct experiment; a portion of the axillary artery of a horse which had suffered from severe inflammation, was placed horizontally between a perpendicular column of mercury and a graduated tube containing water; the contractile power of the artery was made to expel a portion of the water, the quantity of which, as indicated by the graduated tube, was consequently a measure of the contractile power or tonicity of the artery, which was found to be in the artery of the diseased limb as compared with that of the sound one, as 19 to 16. Similar results were obtained from observation on the power of redilatation of the structures after their

final contraction at the moment of death. The blood is in a state of accelerated motion towards the inflamed part; where it is retarded, the fibrin seems to be increased, with a stronger disposition to concretion or coagulation. From the previous considerations, the learned gentleman proposed the conclusion, that the increased vital action of the blood during inflammation, was not communicated by the coats of the vessels, but that its cause and seat must be sought in some other situation. He thought this question required further investigation.

Dr. ALISON next proposed to the Section some interesting speculations on the power of atmospheric air in promoting the circulation, which he held to be otherwise than by its mechanical influence. On leaving a rabbit for some time in azote, and removing it before asphyxia had been completed—before even its respiration was much altered, he found, on destroying the animal instantly, that its circulation had been interfered with as completely as if it had been entirely asphyxiated; the right side of the heart was in strong action, but could not transmit the blood through the lungs. The learned gentleman answered some objections which might be urged from the contractile properties of the capillaries; and observed, that the only conclusion we can come to, in the present state of our knowledge is, that atmospheric air, applied to the blood in the lungs, promotes its passage through these organs in a manner wholly inexplicable. The motion of the blood through the lungs appears to be determined by a cause independent of any impulse from the containing solids. This view of the question appears to be borne out by what is observed in vegetables and the lower tribes of animals, in which the fluids move without any contraction on the part of their containing solids; and seems to be confirmed by the vibratory motions of the ciliæ, as observed by Purkinjie—motions which he (Dr. A.) seemed inclined to attribute to spontaneous currents in the fluid itself.

Surgeon WHATTON, of Manchester, described a new operation practised by him for the cure of caries, or injury of the bones of the foot requiring amputation, which consisted of a removal of the lateral half of the foot, leaving the other half to serve as a proper support in walking. He said, that as far back as 1811, during the Peninsular war, his attention had been drawn to this subject. At that time, when the bones and soft parts of the foot were injured by balls or fragments of shells, the usual practice was to amputate transversely, either at the tarso-metatarsal union, or higher up at the astragulo-scaphoid and calcaneo-cuboideal. Since he had been appointed to the infirmary at Manchester, he adopted a different mode of operating, which was attended with very superior advantages. He had adopted this plan after a careful study of the relative anatomy of the foot, and was not aware that there was any such operation on record. He tried the operation in a great number of cases, and found it to answer extremely well; of this he hoped he should be able to convince the meeting, as he had an opportunity of showing a patient on whom the operation had been performed, and who was able to walk twenty miles a day. Finding that all ordinary modes of treatment had proved ineffectual, Mr. Whatton decided on the longitudinal operation, which was performed in the following manner. An incision, commencing at the root of the fourth toe, was carried, in a slightly curved direction, towards the extremity of the fifth metatarsal bone, and terminated near the outer malleolus. This incision was made on the plantar surface of the foot. A similar incision, commencing and terminating at the same points, was carried along the dorsum. The flaps being dissected off, the knife was carried between the two outer metatarsal bones, down to the cuboid. The outer edge of the os calcis, being found diseased, was also paired off with the scalpel. The second incision removed the next toe and its metatarsal bone in a similar manner, leaving three toes with their corresponding tarsal bones. There was considerable hæmorrhage after the operation, and it was thought advisable to defer dressing the foot, until the patient was placed in bed. The wounds healed kindly, and the man was discharged about twelve weeks after the operation, perfectly well. A cast of the foot was taken ten months after the operation; this shows some fulness about the teguments of the tarsus and metatarsus; but in a cast taken twenty months after the operation, a manifest improvement is visible. Mr. Whatton here exhibited the casts, which he stated he should feel great pleasure in presenting to the Royal College of Surgeons of Dublin. The patient operated on was exhibited to the meeting. He walked up and down, with as much ease as a person who had the perfect use of his limbs; and on being required to stand on the leg, singly, he made the attempt in such a manner as to show that he possessed a considerable power of balancing himself. Mr. W. stated, that it was his intention to follow up the subject, and bring it again before the Section.

Dr. GRANVILLE said, that the operation so ably detailed by Mr. Whatton, indicated a new era in surgery. Assembled as the meeting was, to promote the interests of science, it was their duty to take into consideration the immense advantages which this admirable operation possessed. He was certain that an operation of this kind would have preserved many efficient members of the army and navy, whom the transverse operation or amputation of the leg had rendered useless burthens to the country.

Mr. CARMICHAEL looked upon the operation as exceedingly valuable. In Chopart's operation, the limb was very little better than a wooden leg; this left the patient the full power of using it.

The thanks of the meeting were then voted unanimously to Mr. Whatton.

Dr. WILLIAM STOKES read a paper on the diagnosis between accumulations on the chest of fluids and of air, the products of diseased action, and pointed out a new ground of distinction arising out of the paralysis of the respiratory muscles, from inflammation in their immediate neighbourhood. Dr. S. concluded by stating, that his observations and suggestions should be tested by future investigation.

Dr. EVORY KENNEDY read a report on the purulent ophthalmia of infants, derived from observations in a great number of cases in the lying-in hospital. With respect to the treatment of purulent ophthalmia in children, much difference prevailed. Some treated it with sedatives, others with stimulants; a third class restricted the use of sedatives to the early stage of the disease, and then had recourse to stimulants and astringents. He would proceed to state the means which he had found most efficient. One of the first and most necessary steps in the treatment was the application of leeches. One of these was applied to the inflamed lid, or to the temple in the immediate vicinity of the eye; the former situation was, however, generally preferred. After leeching, the common practice is to have recourse to fomentations, aperients, and astringent collyria. Dr. Kennedy did not think this a mode sufficient; to treat the disease with effect, it was necessary to produce an altered action in the diseased parts. In obstinate cases, besides leeching and the nitrate of silver, alterative aperients were employed. Scarification of the lids was not resorted to in any case, and Dr. Kennedy thinks that in the early stage it is objectionable. A close and constant attention to cleanliness was found to be of the greatest use; and he had observed that those nurses, who were careless in washing the eyes of the children after birth, had the greatest number of cases in their wards. The success attending this practice was seen in the rapid subsidence of the disease. On the second or third day, the infant was able to open its eyes, and the worst cases yielded in ten days. Where the disease was protracted, owing to local or constitutional debility, the muriated tincture of iron was given in the breast milk, and occasionally the vinum opii was dropped into the eye.

Dr. BEATTY said, that having the superintendence of a similar institution, he could confirm many of the foregoing statements. With regard to treatment, his experience differed in some points from Dr. Kennedy's, particularly as regarded the application of leeches. He had been desirous of testing the merits of treatment, omitting the use of leeches, and had found that a recovery took place as certainly in those cases where no leeches had been used as where they had been employed. His treatment consisted at first in the use of cold applications to the eye, constantly repeated, and the use of alterative aperients, and afterwards of the saturated solution of the subacetate of lead, as recommended by Dr. Jacob. If no improvement followed the use of the liquor plumbi, in two or three days, he then had recourse to the solution of nitrate of silver, of the strength of ten grains to the ounce or more. He had found the five grain solution quite inefficient.

Mr. Byrne, Dr. Collins, and Dr. Ireland stated their opinions to be much in accordance with Dr. Kennedy.

Dr. PERRY, of Glasgow, read a paper on typhus fever. He stated as the general results of his experience in three thousand cases, that typhus is an exanthematous disease; that it seldom affects the same individual twice; and that it is very rare in the early periods of life.

A paper was read from Mr. KNOWLES, of Birmingham, detailing a successful case of Cæsarian operation, from which the mother had perfectly recovered, and both she and infant were now doing remarkably well.

Surgeon BYRNE made a communication respecting the result of his experience in the treatment of patients in the Lock Hospital.

Mr. LESTRANGE exhibited the action of 'a new curved drill catheter' to the section, which, after being introduced with any required elevation or depression, could be firmly fixed to a table by means of

a cramp to which it was attached, and the powerful action of the drill applied to perforate a calculus previously grasped by the instrument; this was found capable of breaking up calculi which resisted the action of the screw perforator, and the hammer.

Dr. CORRIGAN read a paper on the mechanism of a peculiar sound, to which the technical name of *Bruit de Soufflet* is given. This curious sound, sometimes a perfect trumpet tone, is heard in certain diseased states of the heart and larger blood-vessels, and has become of great value in ascertaining the nature of the diseases. To discover the cause of a phenomenon so singular as this sound in living bodies has been an object anxiously sought for, and the more anxiously since it has become a valuable aid to the physician in forming his opinions and guiding his treatment. Since its discovery, which is of very modern date, successive writers have attempted to account for it, but it has been heard under so many different forms that, Proteus-like, it constantly escaped their grasp. Dr. Corrigan applied to its investigation experiments, guided by an application of the laws of natural philosophy to the passage of the blood, and explained its production by the changes which disease may cause in the velocity and manner of the blood flowing through the blood-vessels. He laid down a theory as to the efficient cause of this sound, deduced both from observation and experiment, and applicable to the different and even opposite conditions of the heart and great vessels in which it is known to exist. After showing that the causes assigned by Laennec and Williams were insufficient to account for all the cases in which it was known to occur—as, for instance, in both active and passive aneurism of the heart, in vessels of the pregnant womb, and in aneurismal varix, &c. &c.—Dr. Corrigan explained his own theory by stating that this sound will be heard when, from any cause, the blood will flow through any cavity or vessel in what he termed "a current-like motion;" that is, in different directions through a cavity too large for the entire mass. This he farther explained by representing the normal condition of the blood's motion to be that of an equably moving stream, flowing *en masse* without any diverging currents, and showed how conditions giving rise to this current-like motion existed in all these, even opposite pathological states, in which it was found.

An interestig discussion ensued, n which Dr. Harty, Dr. Williams, and Mr. Carlile, took a part, and the Surgeon-General having expressed his gratification, and offered some valuable suggestions as to future experiments, moved the thanks of the meeting to Dr. Corrigan, which passed unanimously.

SECTION F.—STATISTICS.

The business of this Section commenced with the reading of a very valuable and ably drawn up paper by Colonel Sykes, upon the state of education in the Deccan. The Deccan, he observed, was an immense district, containing about ten thousand square miles; and the ignorance of the inhabitants was almost incredible. In many villages there was only one accountant, and not two persons who could either read, write, or calculate. This state of ignorance had not its origin in any physical causes, for the native children of all castes possessed great aptitude and intelligence. They had been instructed in English schools; and evinced much ability, especially in drawing, poetry, and the mechanical arts. The gross ignorance of the natives there was to be referred to the absence of the means of instruction, and the poverty of the people. It would be the best plan in the practice of any schools which might be established, to translate European books into the native languages; for thus would be created a greater degree of union of opinion between the governors of the country and the governed. Colonel Sykes referred to the influence which the followers of Mahomet obtained over the Mahrattas by mixing with them, in order to prove that the belief of the Hindoo habits and opinions being unchangeable was ungrounded. The government schools in India were unhappily very limited; but the progress of knowledge, though slow, would prove of great efficacy, for each instructed pupil sent into their country and homes would convey information to others. In the dawn of civilization, Europe owed to India all her knowledge, and it would be now but an act of justice to repay the debt, with the interest which had accumulated in the meantime. In answer to various questions put with reference to the subjects contained in the paper, Colonel Sykes observed, that missionaries had been successful in establishing schools, but only on the coast. Government did not sanction, but only permitted the formation of those schools; for, to give them directly any patronage by the authorities, would be to excite an insurrection in India. Nothing existed to preclude native females from receiving education: and, in truth, women in India, notwithstanding the condition in which they were placed, exer-

cised that influence there which they also exercised every where else. The conversion of a Hindoo to Christianity caused him rather to forfeit than to gain caste, for being accustomed to the observance of ceremonials and fasts while professing their primary faith, the neglect of them afterwards was considered the loss of their purity. Some of the prejudices of the Hindoos were, however, beginning to be effaced from their minds, and difficulties had been got over which formerly might have been considered as insuperable. The son of the celebrated Tippo Saib, and some of the fire-worshippers were now travelling in England, mixing with the population, and acquiring knowledge. It was thought they never could have been induced to go on board ships, as water, essential for some of their observances, could not be procured. This objection had been removed, and now whole regiments passed in vessels from one of the presidencies to another. The same thing occurred with respect to the wearing of leather, because it being prepared by the lowest caste, any thing coming from their hand was objectionable. Now leather stocks were generally worn, and also boots. It was by gentle influences, and not by force, that prejudices were to be removed. A British general insisted upon the Sepoys wearing a certain cap, and the consequence was that the regiment mutinied, and a massacre ensued. During the last war in India, some men were required to throw up entrenchments around the camp. To touch dead bodies is regarded as pollution, and these men in digging the trenches turned up some bodies. This created a horror in their minds, and it was only by using gentle remonstrances, and reminding them of the duty owing to their country and King, that they were induced to proceed with the work. The same species of objection was raised to the sweeping of the parade ground, sweepers being of the lowest caste; and instead of resorting to foolish violence, the officers commenced sweeping the ground themselves, and the evident result was, that the soldiers were shamed into disobedience of their prejudices. The natives now were beginning to adopt European habits—acting as justices of the peace, sitting on juries, &c., &c., and it only required the promotion of education to receive such durable results on their minds and feelings.

Dr. W. C. Taylor observed, that it appeared from the history of the university of Madura, that, previous to the Mohammedan invasion, persons of even the lowest cast, distinguished for their intellectual attainments, were elevated to rank and station; and he thought that education would be more successful in India, if government promoted the natives, who were most remarkable for their knowledge, without any reference to caste.

The Rev. Dr. Singer read an extract from the report of the Church Missionary Society, by which it appeared, that natives of high and low caste attended together the schools established by that Society in the Madras Presidency.

The Rev. E. G. Stanley read a paper on the religious attendances and state of education in the parish of Alderly in Cheshire, from which it appeared, that about one sixth of the population attend day schools, one-tenth Sunday-schools, one-sixth attend morning, and one-tenth evening service, and one-sixth communicants. There are no dissenters in the parish.

Dr. Reid delivered his views upon a plan tried in Edinburgh, for the extension of the study of physics. He proposed to have large classes formed for observing chemical experiments, and that nothing should be employed in these which were not easily procurable by every person. A bit of glass, such as glaziers throw away, a piece of charcoal, and a blowpipe would be instruments enough with which to make from one hundred to one thousand experiments, and these would illustrate the essential operations of chemistry. By this means a peculiar knowledge would be obtained, and the mode of conducting an examination on a small scale. Dr. Reid here made some experiments on a small piece of glass, and afterwards on paper, showing the formation of crystals, &c. &c., and the effects were as distinctly marked as could be desired. He recommended that the pupils should write down on paper at the time, the changes observed by them during the experiments. Dr. Reid then made some beautiful experiments by applying tests to different liquids and solids. He took some lead ore, and adding nitric acid to it, myriads of little globules were at once reduced from the ore, and fell upon the paper.

The lecturer said that a common beer bottle with a tube, and another bottle for a receiver, would answer for the preparation of gases; and the conducting of operations on a small scale was the better to the student, as the substances passing from one state to another were distinctly seen in a simple apparatus. From calculations made in different places he found

that from £2 to £5 would provide apparatus and materials sufficient to show many thousand experiments. The great object was to render this department of knowledge accessible to all persons, and as to the time its study should be commenced, he (Dr. Reid) would say from three to nine years of age would not be too early. This species of information was easier of acquisition than that of language. The greatest difficulty with children was to arrest their attention,on account of the liveliness of their sensations, and abstract subjects were not sufficient to excite interest. Objects in external nature they observed, and were ready to attend to any instruction afforded in reference to them. The talented lecturer then noticed the necessity of persons devoting a short time to understand the principal practical results of chemistry in relation to the knowledge of the purity of water, the component parts of agricultural materials, &c. &c. This species of knowledge would be of the highest utility to the emigrant, and by imparting it to the natives of the district in which he located himself, he would be elevating the character of his own countrymen, and receiving the friendship and support of strangers.

Some questions having been asked of Dr. Reid at the conclusion of his discourse, he observed that he had a work in the press upon the subject,which would enter into every matter of detail which he thought important to be known.

The Section then adjourned.

DINNER PARTY AT THE VICEREGAL LODGE.

The Lord Lieutenant entertained the officers and several of the leading members of the British Association at dinner this evening, at the Viceregal Lodge. The dinner was served up in a style of great elegance. On his Excellency's right sat the Provost of Trinity College, President of the Association, and on his left Lord Cloncurry. The following personages were also of the party :—Count Jarlsberg, Baron Jarlsberg, Baron de Tolly, Sir Thomas Brisbane, Sir Alexander Crichton, Lieut. Colonel Colby, Mr. Thomas Moore, Doctor Jerrard Moll, Mr. Charles Babbage, Mr. Roderick Murchison, Professors Sedgwick, Powell, Phillips, Hamilton, Lloyd ; Doctors Thomas Thompson, Robinson, Dalton, Daubeny, Peithman, (Berlin,) Prichard, Capt. Ross, Mr. Taylor, Mr. Ticknor, (Boston, United States,) Mr. Whewell, M. de Tocqueville, M. de Montalimbert, M. de Verneuil, and the members of his Excellency's household. The band of the 2d Dragoons played several pieces of music during the evening.

DINNER AT SALT HILL.

Marsh's hotel at Salt-Hill was fixed upon at which to hold the ordinary for the day. So many individuals arrived at Salt Hill, that it was found necessary to have the two great rooms, and three smaller ones in the establishment appropriated for the accommodation of the guests.—Upwards of 300 dined, and the profusion and excellence of the viands were such as to afford the utmost satisfaction. The stewards exerted themselves most creditably to secure the comfort of every individual member present. In the lower great room Captain Portlock, President of the Zoological Society, presided.—After dinner the chairman proposed the health of "the King," which toast was received with the usual demonstrations of respect.

The Chairman again rose and said, that he could not but notice with gratification that spirit of conviviality, which was at that moment the business of the Association. These pleasurable, though of necessity brief meetings, were one means of stimulating persons, who would be otherwise unwilling to join in the pursuit of science.—There was also the stimulus of praise, grateful indeed to those whose intellects were devoted to the benefit of their fellow-men. If those by whom he was surrounded saw a person leaving his native home for the pursuit of knowledge, should they not be grateful, and do him honor on his return after a long interval? Such an individual sat near him, and the company by receiving Dr. Coulter's health as it deserved, would give him the best reward, the testimony of their approbation, and an appreciation of his exertions.

Dr. COULTER briefly returned thanks.

The Rev. Mr. STANLEY having proposed the health of Captain Portlock, and that gentleman having briefly returned thanks, the members retired at half-past seven o'clock.

The chair in the upper dining room was taken by L. W. NAPER, Esq. of Loughcrew, supported on his right and left by Colonel White of Woodlands; Professor Agassiz, Dr. Lardner and several individuals of eminence.

The health of Mr. Vignoles, the Engineer of the

Kingstown railway, having been proposed, Mr. Vignoles, in returning thanks, alluded to the difficulties which the Directors had to contend with in the commencement of the undertaking. The most gloomy anticipations were formed, and the greatest misrepresentations resorted to, to verify these predictions; but he was proud to say that the work had eminently succeeded (cheers.) One or two toasts more having been proposed, the company retired at an early hour, and returned to town in a train specially reserved for them.

EVENING PROMENADE IN THE ROTUNDA.

It having been arranged that no lecture would take place this evening at the Rotunda, the round room and gardens were opened for an evening promenade, which was most fashionably and numerously attended. Most of the *sçavans* in town enjoyed this opportunity of social intercourse with our fellow-citizens. The gardens were brilliantly illuminated, and the fine bands of the 7th Dragoons and of the 14th Regiment played alternately several of the choicest musical compositions. The long room was also laid out for the accommodation of the company, refreshments of every description, ices, &c. being abundantly supplied, under the direction of Mr. Mitchell. The company did not separate until nearly twelve o'clock.

MEETINGS OF THE ASSOCIATION, FRIDAY, AUGUST 14.

DEJEUNER AT THE BOTANICAL GARDENS.

This morning, at the private expense of certain members of the Royal Dublin Society, a *dejeuner*, on the most costly scale of elegance, was provided at the Botanical Gardens of the Society, Glasnevin, for the entertainment of the strangers, and such of our fellow-citizens, members of the British Association, as felt desirous of meeting them. The array of beauty and fashion assembled there, gave additional lustre to a spot already replete with some of the most delightful productions of nature. These gardens are at present in a high state of perfection, and the Royal Dublin Society has reason to feel proud of the unqualified pleasure expressed by all their distinguished visiters. The *dejeuner* was laid out in marquees, eighteen of which, laced together, were pitched in crescent form, and two others, detached, were appropriated to the accommodation of officers of sections, in order that they might partake of the refreshments before the general company, and proceed to town without delay. At ten o'clock the entire company sat down to a most sumptuous entertainment, provided under the direction of Mr. Shields. Ices, fruits, confectionary, &c. were all in perfection. Certain members of the Royal Dublin Society acted as stewards, with great assiduity and attention, and were distinguished by a blue ribbon. Two military bands, of the 7th Dragoons and the 18th regiment, played during the day some of the most admired pieces of music. More than thirteen hundred persons partook of the entertainment. After the *dejeuner* the company walked about the gardens and grounds, where many of them remained until after four o'clock.

SECTION A.—MATHEMATICS AND PHYSICS.

Dr. Apjohn gave an oral account of two papers recently read by him before the Royal Irish Academy, and which appear in the number of its Transactions just published.

One of the most interesting questions in Meteorology, respects the amount of moisture at any time present in the atmosphere, and several instruments have, it is well known, been devised for ascertaining this important point by direct experiment. They are, however, either so imperfect, or so difficult to use, that the British Association at its meeting in York, enumerated amongst the desiderata in physical science a correct theory of the moist-bulb hygrometer, an instrument very easily observed, and whose indications were long suspected to have some relation to the dew-point capable of mathematical expression, but which relation no one had as yet attempted to point out except by formulæ of a tentative and approximate character. Dr. Apjohn, in the first of his papers, gives a direct, and at the same time an exact solution of this problem, and the expression at which he has arrived is characterized by such singular simplicity, that it may be thus easily conveyed

without the aid of symbols. *If from the tension of vapour at the temperature of the hygrometer we deduct a fraction whose numerator is the depression of temperature of the hygrometer beneath the air, and whose denominator is the number 87, the residue will, at the mean altitude of the barometer, be the tension of vapour at the dew-point.* At any other altitude of the barometer than 30, the subtractive quantity is to be multiplied by the ratio of the existing to the mean pressure. Certain other corrections would also in strictness require to be applied, but experience has satisfied the author, that in practice they may be safely neglected, as they scarcely ever reach in amount the inevitable errors of observation.

In his second paper a number of experiments are detailed, instituted for the purpose of testing the value of his formula, and which demonstrate that it represents observations with an extraordinary precision. These experiments were contrived so as to put it to the severest trials, and in no instance did theory and observation differ by more than one-third of a degree Fahrenheit. This communication, relating as it did to the solution of a question which had emanated from the Association, excited an unusual degree of interest.

A memoir by the Rev. Mr. CHALLIS on the simultaneous vibration of a cylindrical tube, and the enclosed column of air, was read by Professor Hamilton, as Secretary of the Section.

Professor WHEATSTONE communicated to the Section an interesting account of the various contrivances which have been made to imitate the human voice—from the speaking machines of the ancients to those of Kempelen and the German mechanists, and the instrument for the production of the vowel sounds contrived by Mr. Willis. The Professor explained the general principles of machines of this nature, and illustrated their effects by experiments. In one of these instruments a pipe, whose length could be altered at pleasure by a moveable piece at the end, was made to sound by a reed, the air being supplied from a large bellows. By altering the length of the pipe while sounding, it was made to give the vowel sounds and their various combinations.

In a more perfect form of the speaking machine, of his own contrivance, the effects were produced partly by a set of valves, governed by keys, through which the air was admitted to the tube, and partly by the modifications in the form of its mouth which were effected by the hand. The instrument uttered the words 'papa,' 'mamma,' 'summer,' and many others with much distinctness.

Mr. WHEWELL exhibited and explained to the Section a new anemometer, which was so contrived as to indicate the direction of the wind, as well as its intensity, and to register its own indications. It consisted of a set of revolving vanes which, by the intervention of an endless screw and ordinary wheelwork, was made to give a vertical motion to a tracing point. This point was kept in contact with an upright cylinder by a spring; and as the rest of the apparatus had a motion round a vertical axis by which it followed the course of the wind, it is obvious that the curve traced by the pencil on the cylindrical surface will exhibit the direction of the wind as well as its velocity.

Captain Sir JOHN ROSS alluded to the means adopted by him, during his last voyage, to register the direction and velocity of the winds, the barometer and thermometer, from observations as accurately made as circumstances would admit of, every half hour. He expressed his doubts of the applicability of Mr. Whewell's instrument in the Arctic regions, but said he would have wished to have had such an instrument with him on his last voyage as the one then submitted, in order to test its utility and accuracy.

Professor LLOYD gave an account of the progress and results of the magnetical observations undertaken by Captain Sabine and himself in Ireland, in compliance with the recommendation of the British Association.

These observations are threefold:—First, the observation of the dip, according to the received method; secondly, the observation of the horizontal component of the terrestrial magnetic intensity, by the time of vibration of a needle suspended horizontally, according to the method of M. Hansteen; and thirdly, the observations of the dip and intensity at the same time, and with the same instrument, according to the method suggested by Professor Lloyd, and laid before the Association at its last Meeting.

The following table gives the results of the observations of dip now made, reduced to the present epoch:—

Place.	*Dip.*
Broadway (Co. Wexford) ..	70°.23'.9
Cork........................	70. 31. 1
Waterford	70. 38. 5
Rathdrum (Co. Wicklow) ...	70. 41. 5

Place.	*Dip.*
Gorey (Co. Wexford)......	70°. 48'. 8
Dublin....................	70. 51. 0
Limerick..................	70. 57. 0
Glengariff (Co. Cork)	70. 58. 4
Ennis.....................	71. 1. 2
Killarney (Co. Kerry)......	71. 1. 5
Tulla (Co. Clare)..........	71. 12. 8
Colerain (Londonderry)	71. 11. 9
Carlingford (Co. Louth)	71. 15. 2
Galway....................	71. 20. 8
Armagh	71. 27. 2
Enniskillen................	71. 45. 0
Strabane (Co. Tyrone)........	71. 45. 0
Carn (Innishowen)	71. 45. 9
Markree (Co. Sligo).........	71. 54. 4
Achill Sound (Co. Mayo) ...	71. 54. 5
Ballina (Co. Mayo)...........	71. 59. 0
Belmullet (Co. Mayo).......	72. 1. 4

It appears from the foregoing table that the dip is least about Carnsore Point, in the County of Wexford; and that it is probably greatest at Erris Head, in the County of Mayo; the extremes differing by more than a degree and a half. The line of 72° dip will perhaps be found to intersect Ireland a second time, about the North-west point of the County of Donegal.

The magnetic intensity has been observed at all the foregoing places, and in most instances by the two methods above alluded to. Observations of intensity have been taken likewise at Clonmel, Ballybunnyan (Co. Clare), Templemore (Tipperary), Leenane (Joyce's Country, Co. Galway), Oughterard (Co. Galway). The entire series will be connected with observations made elsewhere, by a direct comparison of the intensity in Dublin and in Limerick, with that in London. From a very detailed series of observations made by Captain James Ross and Captain Sabine, it appears that the total intensity in Limerick is 1.0244, that in London being unity. The intensity in Dublin is somewhat less; but Professor Lloyd hoped to render the determination of the force at that station more complete by additional observations, before the close of the present summer.

From the observed laws of magnetic distribution, and especially from the results obtained by M. Ermann, in Siberia, it is at once apparent that the lines of equal dip and of equal force are not parallel; as they should be according to the theory of two magnetic poles, in which the intensity is a function of the dip. This non-conformity of the two classes of lines is, on the other hand, in complete accordance with the theory of M. Hansteen, of which Captain Sabine has recently given an account to the section. The angle formed by these lines in the British islands is small, but the observations hitherto made in Ireland seem sufficient to manifest its existence.

Besides the immediate purpose of the present researches in completing, as far as this island is concerned, our knowledge of the empirical laws of the distribution of terrestrial magnetism; they will, it is hoped, be found to furnish also the materials for the elucidation of other important phenomena—as for example, the changes of the magnetic force and direction dependent on time. Professor Lloyd stated that it already appeared from his observations that the dip in Dublin was decreasing at the rate of about 3' annually, which accords with the rate of diminution observed by M. Kuppfer in St. Petersburgh.

Professor Lloyd adverted finally to the difficulties connected with these determinations, arising from the irregular and accidental fluctuations in the amount and direction of the magnetic force; fluctuations which were in many instances greater than the differences to be measured. The only mode of determining the amount of these variations is to have a regular series of observations carried on at some fixed station; and this, among other things, may serve to show the value and importance of the magnetic observatories, which have been established in various parts of Europe, and whose erection in Great Britain has been already called for by the British Association.

Mr. M'Cullagh stated to the Section a new and very general theorem in Physical Astronomy.

It is known that the major axis of an elliptic orbit described round a fixed centre of force placed in the focus, depends only on the distance of any point of the orbit from the focus, the velocity at that point, and the absolute intensity of the attracting force. The major axis is a known function of these three quantities; and in this sense we may speak, in the abstract, of the major axis due to a certain velocity, distance, and force. In a system of any number of planets, find the major axis due to the *relative velocity* and *mutual distance* of any two of them, and to an attracting force equal to the *sum of all the masses;* and divide the product of the masses of these two planets by the axis major so found. Do the same for every pair of planets, and the sum of all the quotients will be constant. The theorem is rigorous

and is no more than a transformation of the equation of *vis viva*. An approximate theorem, well known in Physical Astronomy, may be inferred from it, by introducing the supposition of one predominant mass, such as that of the sun in the solar system.

Doctor KANE gave an account of some phenomena connected with the interference of sound; and related, in particular, the results he had obtained in performing an experiment of interference suggested by Sir John Herschel.

The Section then adjourned; but many of the members assembled on the succeeding mornings, to witness at leisure the phenomena adverted to in the papers of Mr. Snow Harris, Professor Wheatstone and others. This interest was kindly responded to by the gentlemen just mentioned; and nothing was left undone which could tend to give a clearer view of the results of their important communications.

SUB-SECTION A—FRIDAY.

Mr. ETTRICK read an account of certain improvements in steam-engines, for rendering available the steam of high pressure boilers which is below the pressure of the atmosphere, by permitting the high pressure steam to pass off into the atmosphere; and the steam of low pressure to pass off into a condenser by a secondary slide. He also gave a report of certain improvements in securing the steam-boilers, by longitudinal, instead of the present circular clenches. He also described a machine for drilling boiler plates, as rapidly as they can be punched by the punching machine. He also gave an account of certain improvements in the astronomical clock, which could not well be explained without the aid of diagrams.

Mr. CHEVERTON read a paper on mechanical sculpture, or the production of busts and other works of art by machinery, and illustrated the subject by some exquisite specimens of carvings in ivory, which were reduced copies from celebrated sculptures. They were beautifully executed, and excited universal admiration, particularly copies from the crouching Venus, and the Townley Isis. The machine, like many others, produces its results through the medium of a model, to govern its movements; but it has this peculiarity, that the copy which it makes of the original may be of a size reduced in any proportion; and that it is enabled to effect this result, not merely on surfaces such as bas-reliefs, but likewise in busts and statues.

Professor STEVELLY described a Self-Registering Barometer, which it was thought would prove very important in meteorological observations.

During the oscillations of the common barometer, when it falls, a certain quantity of mercury is added to that already in the cistern, which, of course, increases its weight; on the contrary, when the barometer rises, mercury goes from the cistern into the tube, and the cistern is by so much lighter than before. If, then, the tube of a barometer be firmly fixed in its place, but the cistern be by any means so suspended as to move downwards by arithmetical distances for equal additions to its weight, and to rise similarly for similar diminutions of its weight, it is clear that, a scale being fixed beside it, an index, carried by the cistern as it falls and rises, may be made to mark on the scale a variety of positions corresponding to the falling and rising of the barometer. But the range of this scale, as shall be proved, may be made to bear any desired proportion to the three-inch scale of the common barometer. Supposing, for an instant, what has been just stated to be accomplished, it is obvious that a pencil may be so attached to the cistern as to rise and fall with it; and thus mark on a properly ruled sheet of paper, carried by a clock across the instrument, the indications of the barometer at the successive hours of the day. Thus, the curve representing the actual diurnal oscillation of the barometer can be placed before the eye, and registered on separate sheets of paper. Also the mean curve can be had by causing the pencil, day after day, to traverse, for a long period, the same sheet of paper, since the pencil marks will become blackest and heaviest on the parts corresponding to the mean curve. Thus all the necessity of the labour of actual observation, registry, &c. will be avoided, and much of the toil of reduction.

The method of suspending the cistern preferred is by a mercurial hydrometer; the cistern, for the sake of stability, being either a long cylinder, suspended from the stem of the hydrometer underneath the instrument, as in Rouchette's modification of Nicholson's hydrometer, or a hollow bucket encompassing the vessel in which the hydrometer floats.

If the stem of the hydrometer was made of a

cross section equal to the internal bore of the barometer, Professor Stevelly showed that the sensibility of the instrument would be too great for practice; the scale being, in that case, lengthened out indefinitely, as the hydrometer would never sink to a position of equilibrium if the barometer fell, and *vice versâ*. But if the cross section of the stem of the hydrometer be twice the cross section of the tube, he showed that the rising and falling of the mercury in the tube of this barometer would be exactly double of the range of the common barometer; and therefore the rise and fall of the cistern would be equal to the rise and fall of the common barometer. Between these limits any desired scale, however long, may be obtained, by proportioning the stem of the hydrometer to the internal bore of the tube. Also a scale less than that of the common barometer, if it were desirable, could be had by increasing the cross section of the stem of the hydrometer. A water hydrometer could also be constructed for the instrument, where it was necessary to save first cost. The vessels should be cylindrical; the tube and all other parts should be of iron.

Professor Stevelly also showed, that an extremely cheap, sensible, and easily constructed instrument, for weighing hydrometrically, could be obtained, by using, as a stem, a steel wire with a gold dot or two on some part of it; an index, or a microscope, being attached to the side of the vessel with cross wire, in which the hydrometer floats, and being moved steadily up and down until it bisects the gold dot, instead of taking the common method of indications from the surface of the fluid. The weight is obtained by placing the substance in the scale of the hydrometer, bringing the index or wire of the microscope to mark the position of the dot, removing the substance, and putting in known weights until the dot is again brought to the same position.* As the adjustment takes place at the instant of using, the instrument becomes almost incapable of being injured by external violence. The common hydrometer, as every one knows, is destroyed by a very slight external injury.

Lieutenant DENHAM, R.N., made some interesting observations upon the effects of vibration upon iron railways, and especially where they passed over tunnels.

Dr. LARDNER delivered some observations upon certain principles connected with rail-roads. He commenced by saying that on account of the commercial and political consequences resulting from the formation of rail-roads, many questions with reference to them became important, although, considered in an isolated point of view, they might appear trifling. He had before stated, in his lecture at the Rotunda, that the perfection of a rail-road would be, to have it entirely and unqualifiedly level. If they wished to connect two points in a country by a rail-road, to do it in a perfect manner, a straight line ought to be drawn from one extremity to the other, and this line should be perfectly level. This state of perfection was not, however, attainable, and they were then obliged to consider with all due care, and take a balance of the advantages which any proposed line offered. He (Dr. Lardner) proposed to call the attention of the section to the effects of declivities and curves upon a rail-road. Having been called some time ago before a committee of the House of Lords, to give evidence respecting two intended rival rail-roads, this led to an inquiry, the result of which at the moment startled him; but this soon vanished, and he only felt astonished at his own stupidity. Every road offers a sensible resistance to traction, but this on a rail-road is less, because the surface is more uniform. The resistance on a rail-road to the power of traction is always the same as the resistance produced by ascending an acclivity rising 1 foot in 250—that is supposing the rail-road to be level. Suppose a rail-road rising 1 foot in 250, the resistance to traction then proceeds from two causes—the resistance on the level, as already explained, and the resistance offered from the actual acclivity. The resistance to be overcome on the level is equivalent to nine pounds per ton, and on the road ascending 1 foot in 250, it would be eighteen pounds per ton; and thus it is seen, that in the latter case the drawing power must exert twice the force necessary on the level. If the road rose 2 feet in 250, the drawing force would be twenty-seven pounds to the ton. This view of the subject is confined to ascents; but it should not be forgotten, that when a rail-road is worked, the transit is from one end to the other. It was necessary, in estimating the merits of rail-roads, to consider their action downwards as well as upwards. In coming down a

* The principle is the same as that of Biot's plan of weighing accurately, even with an imperfect balance; but the hydrometrical application of it is new, and extremely ingenious.

steep, no force is required to impel an engine, and the gravity restores that force in going down which it has robbed from it in the ascent. You had to provide, in an ascent of 1 foot in 250, for a resistance of eighteen pounds to a ton, but descending, no force was required. If it was desired to strike an average between the ascent and descent, the road would present a surface which would be equivalent to a level. This point, respecting ascent and descent, struck the House of Lords as a paradox, but it was one only in sound and not in reality. Dr. Lardner remarked that these observations referred to ascents not more steep than 1 foot in 250; but supposing the rise to be 3 feet in 250, and where the strain would be consequently thirty-six pounds in each ton—would gravity give this back in the descent? It was true that no power was required in descending, but while only nine pounds were gained in the descent, twenty-seven pounds were lost in the ascent. Beside the loss of power, there was also the danger resulting from the too great velocity occasioned by sudden descents. In one of the lines of railway for which a bill had been applied to the House of Lords, there was a slope of 1 foot in 106 in a descent of two miles and a half long, and the velocity given to an engine on arriving at the foot of the slope could not amount to less than 70 miles an hour. To mitigate defects arising from these abrupt descents, breaks were applied, but not always with success. The break is a piece of wood, pressed against the tire of the wheel by a lever, and if it acts with full effect it ought to prevent acceleration. He (Doctor Lardner) had seen several cases in which it had totally failed, and one instance which occurred he would detail. At one of the slopes between Manchester and Liverpool, he was descending with a loaded train of one hundred and fifty tons. The operative engineer, whether through a desire of displaying the rapidity of the engine's movements, or through neglect, did not apply the break at the commencement of the slope; when half way down the velocity became so great, that he (Dr. Lardner) requested the breaks to be applied, but on doing so they were instantly burned. The train went down at a tremendous speed, although the supply of steam had been cut off. When the train had been stopped, it was found that the wheels of one of the waggons which revolved with the axis had been broken, and yet notwithstanding this accidental drag, the speed amounted to about fifty miles an hour. It was objectionable to have any slope exceeding one foot in two hundred and fifty, for when the excessive natural powers of gravitation were resorted to, control over its movements was impossible. The conclusion to be arrived at, although it appears paradoxical, is, that you may construct two rail-roads, say of one hundred miles in length, one level, the other going over mountains, and yet the two railroads may be worked by the same mechanical power. Suppose in the one you ascend one foot in two hundred and fifty, and descend in the same ratio, a pull of eighteen pounds to the ton is required only fifty miles, and on the other half you descend by inertia. On the level road a pull of nine pounds to the ton is required for the entire distance, and thus the extent of exertion is equalised. Doctor Lardner further illustrated his view of the case.—It was not, he observed in continuation, to be forgotten, that they should have a regard to the power used. If the power to be used was that of animals, then it might happen that the hilly road would be better than the level; for nothing was better understood than that a dead and unvarying pull upon the same set of muscles would have the effect of causing the labour to be more severe, while a varying pull would alternately give quiescence and exercise to the muscles. If the line was so disposed as to throw the whole ascent in one spot, the advantage would be gained of having the rest of the road nearly level. But the cost of attaining this advantage should not be forgotten. Steeps of this description required an increased power, and the engines capable of working on the general line of road, would not be capable of exerting an increased force. There were only two ways of performing sudden ascents, one by the agency of an additional engine, and the other, by having the whole train pulled up by means of a rope. The additional engine would occasion much additional expense, for the hands supplying it would always be preserved, and the men should be paid their wages whether wanting or not. The use of the rope would occasion an enormous waste of power, and he would mention the instance of a place where an ascent of one foot to one hundred and six occurred. The rope had to be five miles long, and its weight was sixty thousand pounds. Dr. Lardner next referred to one point on which he seemed to consider that engines generally were at variance with what was correct. He contended that the heat of the fire is directly proportional to the quantity of the steam allowed to

escape in a definite time into the flue, and consequently, that half the number of blasts of steam projected into the chimney in an engine going up a hill, would have the same effect in exciting the fire as double the number of blasts of half the condensation, when the engine was running on a level plane. Dr. Lardner said, that he would merely add one or two words on the effect of curves. The centrifugal force gives a tendency to fly from the centre, and the flange being pressed against the rails produces friction. The flange pressed out against the rails causes it to strike against them, and either the rails are injured or the wheel goes over them. The learned lecturer, after adverting to the abrupt curve at the termination of the Kingstown railway, the radius being not more than half a mile, concluded by saying that in any case it would be most essential to avoid having any curves at the termination of a descent.

Mr. VIGNOLES, in reply to Dr. Lardner's remarks on the curves and inclines on railways, and particularly as to the curve on the Dublin and Kingstown railway between Sea-point and Salt-hill, gave instances of curves of much shorter radius than the curve at Salt-hill having been travelled over at high velocities for several years without accident; and Mr. Vignoles trusted, the actual results of experience would relieve the apprehensions which the fair auditors of the discussion might entertain for their safety, when next they trusted themselves on the K ngstown raliway. Mr. Vignoles mentioned the junction-curve from the St. Helen's railway, on to the Liverpool and Manchester railway, near the twelve-mile post, at the foot of the Sutton inclined plane, which had a radius of only 200 yards on a gradient of one in two hundred. The curve on the junctions of the North Union Railway from Preston and Wigan, with the Liverpool and Manchester railway, near the seventeen-mile post on that line, not far from Parkside bridge, where Mr. Huskisson was killed, was drawn with a radius of about 550 yards, and had a gradient of 1 in 377; and on this curve the railway trains had travelled daily for three years at high velocities, not only without accident, but without having sensibly put the rails out of guage; that is, that the original parallelism of the rails had not been materially or sensibly affected. Mr. Vignoles also mentioned—in opposition to Dr. Lardner's remark, that the climax of danger was to be apprehended from a curve immediately commenced at the foot of an inclined plane—that on the Runcorn-Gap railway, he had frequently ran down the self-acting plane with several waggons, without breaks, at the highest velocities, and without accident. The plane was graduated 1 in 36; and at the foot a curve begins with a radius very little more than the radius of the Salt-hill curve on the Dublin and Kingstown railway, and with a gradient of 1 in 330—and down this inclined plane the coal waggons continually ran without accident.

Mr. Vignoles then proceeded to state that the curve near Salt-hill was described with a radius of about half a mile, or 880 yards, and was on a horizontal or dead level for the principal part of its length, and on a gradient of 1 in 400 for the remainder.

Mr. Vignoles took occasion to remind Dr. Lardner, that it was extremely easy to counteract the effects of the centrifugal force acting on trains passing along curves at high velocities, by elevating the outer or convex side of the railway; and that the maximum or even the average velocity being assumed, and the radius of the curve, or rather (as Mr. Vignoles observed from a more correct expression furnished by Mr. Cubitt, to the Institution of Civil Engineers) the radius of the curvilineal motion of the centre of gravity of the locomotive engine or load, being known, a very simple formula was obtainable, which gave the measure of the necessary elevation of the outer rail of the road above the inner rail, in order to counteract the effects of the centrifugal forces.

Mr. Vignoles also produced a most interesting collection of papers on railways, embodied in the American Railroad Journal, a publication already extended to six respectable quarto volumes; and alluding to some great lines of projected railways through the States of New York, observed that the engineer of that work had rather prided himself on obtaining a route on which no elevation would be more than 100 feet in a mile (1 in 53), and no curve of a shorter radius than 100 yards. Mr. Vignoles concurred with Dr. Lardne , that it would be better that a railway should be straight and level, but he protested against the categorical conclusions of the learned professor, which, if

strictly acted upon, would be prohibitory of many useful lines of railway in various countries.

Mr. Vignoles then entered upon the question of the manner in which inclines should be introduced in railways, and contended from his own extensive experience, and from daily observations on the railways in operation, that the most desirable mode was to concentrate the steep inclinations, so that, by the help of an additional engine, the train might be got up with the same full load which the easier gradients on the other parts of the line would allow to be carried.

Mr. Vignoles distinctly denied the assertion of Dr. Lardner, that whether the locomotive engines went at a rate of twenty or of ten, or even of five miles an hour, the same quantity of steam was injected into the chimney in the same time, and thereby an equal draft created; for if Dr. Lardner's assertions were true, the steam pressure, which at the ordinary velocity of twenty miles an hour, was 50lbs on the square inch of the piston above the atmospheric pressure, would have a pressure of 100lbs per square inch, when the velocity was reduced to ten miles an hour, and of 200lbs per square inch when moving only at five miles an hour,—which was a manifest absurdity.

Mr. Vignoles was proceeding to other portions of his reply to Dr. Lardner's statements, and also to illustrate another method of obviating the effects of curves on railways,—as proposed by Mr. Bergin, the resident mechanical engineer, and secretary of the Dublin and Kingstown railway, and illustrated by a beautiful model of a railway carriage which was in the room,—when the chairman of the Section, in consideration of the lateness of the hour, called on Mr. Vignoles to conclude.

SECTION B.—CHEMISTRY AND MINERALOGY.

Professor Davy read a paper on the comparative value of Irish and Virginian tobacco. His researches were undertaken at the instance of the Dublin Society, and had for their principal object the determination of the relative quantities of nicotine in different parts of the plant. The root of our native tobacco he found to contain about 4⅛ per cent of nicotine, and 2⅓lb of it were equivalent in strength to 1lb. of Virginian growth. His other results may be viewed as constituting a confirmation and extension of the previous inquiries of Posselt and Risman on the same subject.

Mr Scanlan rose to say he had repeated his experiments on the new fluid obtained from pyroligneous acid, and he hoped now to be able to satisfy the Section that it was not identical with pyroxylic spirit or the pyroacetic spirit described in books. He had carefully taken its boiling point and found it to be constant; he showed, at one view, the specific gravities and boiling points of pyroxylic and pyroacetic spirits and of the new fluid—thus

	sp. gr.	boiling point.
Pyroacetic Spirit .	828	150
Pyroxylic Spirit .	750	140
New Fluid .	906	130

He showed that the rough product he gets from the pyroligneous acid maker does not yield ammonia. He stated that in repeating his experiments for the Section he had noticed a third fluid, more volatile than any of the other products, which when poured on solid caustic potash, boiled with great violence and rapidity, he exhibited this to the Section.

Dr. Dalton expressed himself satisfied, on seeing difference in specific gravity and boiling point noted down.

Doctor Kane regretted that the experiments which he had suggested on Tuesday, had not been tried by Mr. Scanlan. He (Dr. Kane) still considered it highly probable that the substance contained acetate of methylene, as in its properties it so much resembled that substance. Thus the acetate of methylene had—density, 919—boiling point, 136° f. approaching closely to those of Mr. Scanlan's fluid. An experiment which had been tried before the meeting of the Section, had lent support to this view; the substance having been distilled with sulphuric acid, acetic acid came over, and the residue in the retort yielded with oxide of lead, a sweet soluble salt.

Mr Scanlan said Mr. Kane's argument, in favour of identity of this fluid with acetate of methylene, drawn from comparison of specific gravities and boiling points, did, in his mind, any thing but favor Mr. Kane's view, for this new fluid could be contaminated with nothing but pyroxylic spirit, which would have the effect of lowering its specific gravity; now, were it freed entirely from pyroxylic spirit, its gravity would

be lower than 130 instead of higher. From Dr. Kane's own showing Dumas and Peligot had assigned a higher boiling point as well as a higher specific gravity to acetate of methylene than the fluid in question was found to possess.

Mr. Moore laid before the Section, a leaden pipe which had served for about twenty years as the worm of a still, for the distillation of medicated waters and spirits; at length it began to leak, and on examination, it was found to be supported at various points by bars of wood crossing it and to be tied at others with twine. Wherever it thus came in contact with either wood or twine, it was deeply corroded, and the lead appeared to be converted into a dark powder which, when examined, was found to contain oxide and chloride of lead—at all other points the pipe was perfectly sound. The appearance of the corroded parts was sufficiently against its being attributed to mechanical action. The presence of chloride and oxide in the powder established, he thought, that the corrosion was not entirely, if at all, caused by acids, formed by the decaying organic matter; it appeared to him that it ought rather to be attributed to galvanic action, developed by the contact of the metal, and wood, or twine, which cause, acting for such a length of time, might be sufficient to accomplish the destruction of the pipe at the points of contact.

Dr. Thomson said, no doubt the effect was produced by a weak galvanic action long continued.

A bottle of liquid caoutchouc, as imported, was sent to the Section by Professor Wheatstone, and handed about for inspection.

Professor Barker suggested the application of acetate of potash to the precipitation of peroxide of iron from its solution in the mineral acids; and subsequently drew attention to the fact, that other salts beside the ammonica-magnesian phosphate are precipitated in minute crystals when a glass rod is drawn along the side or bottom of the vessel in which they exist. The bitartrate of potash was mentioned as a case in point. Professor Barker also mentioned the fact, that nitrate of lead may as well as nitrate of barytes, give a white precipitate with nitric acid, in which no sulphuric acid exists, the precipitates being the reagents employed, deprived by the superior affinity of the acid of the water which had previously dissolved them.

Professor Stevelly, in reference to the crystallization of magnesia salt, referred to a statement in Silliman's Journal, wherein it is mentioned that gases were evolved during the rapid crystallization of sulphate-soda.

Mr. Vernon Harcourt observed, that it was a pity persons did not read the works published in their own land on scientific subjects, as the same fact had been alluded to by Professor Graham of Glasgow, in the Edinburgh Philosophical Journal, two years since.

Professor Geoghegan read a paper on a new method of testing the presence of muriatic acid in hydrocyanic acid, which is a proceeding essentially preliminary to the adoption of the usual modes of determining the strength of any given specimen of this agent. The insoluble compounds into which the chlorine of muriatic acid enters, and by the formation of which, chemists usually recognise its presence, are known to resemble, in many respects, those to which cyanogen gives rise, when combining with the same bases. The method proposed by Doctor Geoghegan, is founded on the property which the double salt of the iodide of potassium and bi-cyanide of mercury possesses of being decomposed by acids, and with the formation of the bin-iodide of mercury. This compound, which has been analyzed by Liebig, and subsequently by Dr. Apjohn, is easily prepared by mixing in the proportion of atom and atom, the iodide of potassium and bi-cyanide of mercury, each dissolved in a small quantity of hot water. After a short time silvery scales (resembling acetate of mercury) are formed, which constitute the salt in question. The circumstance of this salt being decomposed by all the ordinary acids, would appear to show, that it is not capable of demonstrating the presence of muriatic acid in particular; but as the only other impurities likely to be present in the hydro-cyanic acid are sulphuric and tartaric acids, if the appropriate tests of these latter do not indicate their existence, then the formation of bin-iodide of mercury on the addition of a crystalline scale, or solution of the double-salt above mentioned, may be considered as furnishing conclusive evidence of the presence of muriatic acid. It may be also stated, that the only hydro-cyanic acid likely to contain sulphuric—that prepared for the ferro-cyanide of potassium—can be generally recognised, as to the source from whence derived, by its

possessing a slight bluish, or bluish green tinge, which is quite distinctive. The mode of detecting the presence of muriatic acid above detailed, has the advantage over those usually employed, of being very readily applied, and the formation of the re-agent perfectly simple; it is capable of detecting a 1-4500th part of the acid; if no change of colour ensue on the addition of the salt, we may conclude that the specimen of hydrocyanic acid contains no impurity which can interfere with the subsequent estimation of its strength. This method, however, is inapplicable to the alcoholized acid of Germany, as the bin-iodide is soluble in spirit, yielding a colourless solution. If the presence of muriatic acid have been ascertained, its neutralization can be readily effected by the addition of successive small portions of precipitated carbonate of lime, as long as any is dissolved; when free, muriatic acid has been got rid of, and not till then, can the estimate of the strength of the specimen under examination be proceeded in, with any hope of a correct result. The method of Dr. Ure, for effecting this latter end, is sufficiently correct for ordinary purposes, if we substitute for the red precipitate which he employs, pure per oxide of mercury; as, independent of the presence of minium and other impurities, red precipitate is seldom, if ever, free from per nitrate of mercury; if perfect accuracy be desirable, the best method, and probably as simple a one as that just alluded to, is the formation of cyanide of silver by the addition of the nitrate of that metal.

Professor Johnston, communicated the results of his recent experiments on the iodides of gold. This body had not been previously obtained pure, and its composition had been misunderstood. He has obtained it in brilliant plates, like iodide of lead; it combines with the basic iodides to form salts. Of these, the learned Professor described several.

Doctor Barker read a brief notice of a curious electrical fact observed by him on two occasions—namely, that a platinum wire traversed by a strong galvanic current, instead of being luminous throughout, exhibited at certain intervals, portions of about an inch in breadth, which were perfectly dark.

Some conversational discussion arose between Professors Johnston and Kane, concerning the nature of the fulminating compounds of certain metals; it appeared to be the opinion that new researches are necessary before our knowledge of their composition can be considered accurate.

Mr. Robert Mallet then read a paper on the preparation from certain varieties of turf or peat, of a white fibre or pulp, for the purpose of making paper, and of certain pigments, resulting as useful educts from the process. He stated thata substitute for rags, (the usual material for paper making) was wanted, owing to their cost, government duty, &c. that various attempts had been made to find one, but without obtaining the conditions to be desired. He exhibited to the Section, specimens of paper made from straw—Chinese paper made from the outer coats of a species of amaryllis; French white paper made from old rope and oakum—and English letter paper, containing a large quantity of plaster of Paris, and mentioned that chopped hair, spent bark, wool combings, cotton flyings, currier's shavings, and even common wood shavings, had been tried as materials for paper making. None of these are found to answer on investigation, therefore it appeared to Mr. Mallet that the confervæ of our fresh waters, or certain kinds of turf, might afford a pulp fit for use. The former was soon found too fragile to endure bleaching; but from the latter, after some experiments, a pulp was procured fit for making good white paper, either alone or in combination with that from rags. Specimens of this pulp, as perfectly white as that from the best rags, were exhibited to the Section.

It is well known that peat bogs, and especially our Irish ones, consist of various strata, differing in density and other properties in proportion to depth. The surface of the bog is usually covered with living mosses, heaths, and various paludose plants, and the stratum immediately beneath, usually consists of a tough, fibrous, light, spongy mass, varying in thickness from a few inches to some feet, and composed of the parts of the same kind of plants which are growing on its surface in the first stage of decomposition. It is of a deep red brown, contains the vegetable fibres nearly unaltered, while the other organic substances of the plants are chemically changed; and the whole is, as to chemical condition, nearly in the state of some of the "papyri" found at the Herculaneum.

The process for producing from this crude material a white pulp for paper is as follows. The red turf when cut is macerated by machinery nearly similar to the ordinary rag engine, until its parts are fully separated, but without bruising or injuring its fibre; and a stream of water running through the machine, carries off all the pulverulent, and mixed earthy matter.

The mass is next dried by pressure in the hydraulic press, and all strong woody stems of heath, &c. contained in it, separated by winnowing or other suitable means.

The fibres of the minute plants—the mosses, grasses, &c. now reduced to a uniform size, and placed in a very dilute solution of caustic potass or soda, containing not more than sixty grains of alkali to a quart of water; for this purpose Mr. Mallet prefers the "black potash" of commerce, which is a mixture of carbonate and caustic potass. After sufficient exposure to this agent, the mass is again pressed to dryness, and then thrown into an exceedingly dilute sulphuric acid, consisting of fifty grains acid of commerce to a quart of water. By the action of the alkali, nearly all the soluble matter, consisting chiefly of ulmin, or geine of the Continental chemists, is removed in solution; and the fibre, which was of a deep red brown, comes out of a light fawn colour; and by the dilute acid, the minute quantity of iron, lime and alumine, &c. existing in it is carried, together with ammonia when it exists; and the last remains alkali are neutralized. The fibre, after sufficient time, is again pressed dry, and, finally, put into a dilute solution of chloride of lime or bleaching liquid; this, after some time, brings the fibres into the state of a pure, white, fine pulp, which is pressed from the solution, washed in pure water, and used either alone or in combination with fibre from rags, for the ordinary purposes of the paper maker.

The alkaline solution, from which the fibre has been separated, consists chiefly of an impure geinate of potass or soda, whichever has been used. Dilute sulphuric acid is added to this, which takes up the alkali and the geine precipitates; it is separated by filtration, and dried by a steam or water bath.

The pigment called "Vandyke brown" has long been known to painters, both in oil and water colours, as a durable and rich colour; the dry precipitate thus obtained is, in fact, this very pigment, in its purest and most splendid state. When once dry, it ceases to be soluble in water, and consequently, is not deliquescent, but it is miscible readily with gum, mucilages, size, or oils.

The quantity of alkali used in this process is small, but, if found worth while, its combination with the acid may be made available in commerce.

After the turf fibre has been for a time exposed to the action of the chloride of lime in excess, in some cases a resinous looking film appears on the surface of the fluid; by operating on a large quantity, and careful management, this may be separated, and is found to be a composite substance, consisting of a species of artificial camphor, of a gum resin, and of an essential oil.

It seems probable, that the first is produced by the action of free chlorine on some minute quantity of turpentine, contained in the turf: and it is a curious fact, that chemistry should thus, as it were, recal to observation, and decompose, the turpentine of plants, which have ceased to exist as living vegetables, perhaps for centuries. The properties of this substance have not been strictly examined, owing to the small quantity in which it is procured; it is ascertained, however, to be a compound, as its boiling point changes during its volatilization. Its specific gravity is about that of common camphor—it is insoluble in water—soluble, to a considerable extent, in alcohol, and the remainder is soluble in proof spirit, appearing to be a gum resin; it does not wholly dissolve in caustic alkalies; strong sulphuric acid converts it into charcoal, and a substance analogous to artificial tannin. It is also partly soluble in volatile and fixed oils, and from the former it crystallizes on evaporation.

Specimens of the white pulp of the bistre, or brown pigment, and of the artificial camphor, were exhibited by Mr. Mallet. The pulp is fully equal, in appearance, to that from the best fine rags, and nearly as tough in fibre; about eighteen pounds of it may be procured from one hundred weight of crude turf. Mr. Mallet also exhibited specimens of a new description of board paper, or mill-board, for engineers' use, prepared from this variety of turf, by an exceedingly simple process. The turf, whose fibres lie naturally very nearly parallel, is

cut of the required size, about two feet square, by three inches thick; when dry, it is placed in a close cast-iron vessel, the air exhausted, and a mixture of dissolved glue and molasses, at a boiling heat, poured over it, which fills up all the pores; the turf is then removed, while hot, and subjected to the pressure of an hydraulic press, by which the superfluous fluid is expressed, and its substance condensed to about three-eighths of an inch in thickness; in this condition it is strong, tough, flexible, and fit for all the uses of common board paper; it is not injured, nor is it permeable by high pressure steam. Various other materials may be used for filling the pores, as boiling coal tar, fat oils, wax, paints, &c.; this would appear to open a most valuable manufacture.

It is worthy of remark, that the kind of turf suited for all the above purposes is precisely that which is the worst possible as fuel, by a singular, natural, but coincident adaptation; there is reason, therefore, to hope that, owing to these and other discoveries, the time may arrive when the bogs of Ireland will be better valued than they have been—when art will show them to be magazines of the richest manure—to be, when properly prepared, a fuel scarcely inferior to coal—and to produce the materials for paper and colours; instead of being looked upon as the blot upon her fair and fertile champaign, they may become the reservoir of her riches, and the residences of her manufacturing industry.

SECTION C.—GEOLOGY AND GEOGRAPHY.

Mr. WHEWELL addressed the Section on the importance of Physical Investigations towards the elucidation of Geological Phenomena. To feel this, it is only necessary to remember, that the great laws which regulate the action and motion of matter are universal, and consequently, that all observable phenomena of matter must be more or less influenced by them, and, therefore, have either a direct or an indirect relation to each other. In this way the phenomena of terrestrial magnetism, such as the existence of four points of magnetic convergency, two in the northern and two in the southern hemisphere, (two being strong and two weak) though explained by rotation of the magnetic poles round the poles of the earth, may yet be connected with those internal changes, of which geological phenomena are the evidences; whilst the great cycles of rotation whether of 900, of 1500, or of 4000 years, afford a clue to the periods of geological epochs. Mr. Whewell next took a comparative view of the opinions of Fourier and Poisson—Fourier deducing a central source of heat from the fact, that on penetrating the earth's surface either by artesian wells or by pits, the temperature increases with the descent, and hence concluding, that the earth, by gradually giving off its original heat, has been progressively cooling, according to the opinions of many geologists; whilst Poisson, on the contrary, doubts the theory of original central heat, and advances that of successive stages of heat and cold, which he explains by supposing that the system, of which the earth is a part, in its passage through space meets with regions of unequal temperature, receiving additional heat or giving off part of that it had previously acquired, according as these portions of space are of higher or lower temperature. And further, as the transit of heat either from or to the internal parts of the earth must be progressive, not instantaneous, that the earth will exhibit the temperature of the space it has just left, rather than that of the portion it at any time occupies. Mr. Whewell concluded by enforcing the value of Captain Denham's researches into the constancy of the half-tide level, by which he had provided a sure base line for testing the amount of geological changes in the relations of sea and land.

Professor PHILLIPS, in reference to part of Mr. Whewell's observations, mentioned that M. Necker had noticed, that the lines of equal magnetic intensity were co-incident with the strikes of the beds or strata over a large portion of the earth's surface.

Professor SEDGWICK and Mr. MURCHISON pointed out the additional proof of the value of such an Institution as the British Association, which had been afforded by Mr. Whewell's communication, since it showed that when men pursuing different branches of scientific research were thus brought together, they were enabled mutually to aid each other by throwing the light of one science over the obscurer parts of another, and thus obtaining the advantages of powerful combination, united to those of division of labour.

Mr. HARTOP described some remarkable heaves or shifts of the coal strata of Yorkshire, the direction of the heave having been to the east and its amount very great, extending to five miles.

Mr. SEDGWICK referred to the explanation of apparently horizontal shifts by vertical faults (or upliftings) of strata; (their previous inclination being preserved) the lower part of a stratum being in this way brought in advance of the upper, as indeed it was though at a lower level, before the fracture and elevation.

Mr. GREENOUGH pointed out the use which might be made of beds of iron stone, in tracing out and characterizing coal fields. Two such beds existed in the Yorkshire field, preserving an equal distance from each other, the iron stone containing muscles; he would, therefore, wish such beds to be attended to in other coal districts as affording a mode of comparison between them.

Mr. PEEL stated, that in the Newcastle district two beds, half-a-yard apart, did exist, but that in the Whitehaven district, though abundant, the iron stone was not in distinct beds.

The next communication was the result of the labours of Professor SEDGWICK and Mr. MURCHISON, who for several years have endeavoured to remove the obscurity which has hitherto hung over those strata which under the name of transition, intervene between the old red sandstone and the crystalline or primitive rocks. Mr. Murchison had indeed extended his enquiries over the old red sandstone—a formation once considered barren of organic remains, though it is now known to contain five species of fossil fishes; and looked upon as of limited extent, though, as Mr. M. has shown, it is sometimes 10,000 feet thick. That investigation was eminently successful, and equally so has been the attempt of Mr. Murchison and Professor Sedgwick to replace a vague and indefinite system by the clear and well marked arrangement, which they propose to call "*The Silurian and Cambrian systems of rocks.*"

Professor SEDGWICK and Mr. MURCHISON gave an exposition of the conclusions at which they had arrived, respecting the order in which the older sedimentary strata succeed each other in England and Wales. Mr. Murchison commenced by describing the great group of fossiliferous deposits which rises out from beneath the old red sandstone. To these rocks, which he has termed in descending order the Ludlow, Wenlock, Caradoc, and Llandeilo formations, (each distinguished by peculiar organic remains, and frequently by subordinate limestones,) it was found essential to assign a comprehensive term, since they constitute one natural system interpolated between the old red sandstone and the slaty greywacke of North and South Wales. He observed that it was well known to all practical geologists, that in consequence of the recent advances of the science, it was absolutely imperative that the term "transition" under which such rocks would formerly have been described, should now be abandoned, since it had been so used both by Continental and English writers, as to embrace the whole carboniferous system, from which the system under review was not only separated by the vast formation of the old red sandstone, but was specially to be *distinguished* by its fossil contents. Urged, therefore, by many geologists to propound an entirely new name for the class of rocks which had engaged his attention during the last five years, Mr. Murchison recently suggested (see Lond. and Ed. Phil. Mag. July 1835,) that the group should be termed the "Silurian System," the name being derived from the ancient British people, the Silures, who under Caractacus made so noble a stand against the Romans, and within whose territory the rocks under consideration are fully displayed. Mr. M. then pointed out, that wherever the typical characters of each formation were absent or obscure, it was nevertheless always practicable, over a region of 120 miles in length, extending from the neighbourhood of the Wrekin and Caradoc hills, in Shropshire, to the west coast of Pembrokeshire, to separate the group into two parts, the "Ludlow" and "Wenlock" formations, forming the upper Silurian, the "Caradoc" and "Llandeilo" the lower Silurian rocks. He further remarked, that in South Wales he had recently traced many distinct passages from the lowest member of the Silurian system into the underlying slaty greywacke, now named by Professor Sedgwick the "Upper Cambrian."

Professor SEDGWICK commenced by pointing out the imperfection of the sections exhibited in the North of England, and some portions of

North Wales, in consequence of the entire want of continuity between the carboniferous series and the inferior schistose groups. An upper fossiliferous greywacke exists both in Denbighshire and Westmorland; but in the interrupted sections of those counties it is impossible to tell how many terms are wanting to complete the series to the old red sandstone and carboniferous limestone. In the country described by Mr. Murchison these difficulties do not exist, and his sections have filled up a chasm in the succession of British deposits. Professor S. then described in descending order the groups of slate rocks, as they are seen in Wales and Cumberland. To the highest he gave the name of *Upper Cambrian group.* It occupies the greatest part of the chain of the Berwyns, and is thence expanded through a considerable portion of South Wales. In one part of its course it is based on beds of limestone and calcareous slate; but on the whole, it contains much less calcareous matter than the Silurian system, and has fewer organic remains. Beds of good roofing slate occur, and we may often observe in it a perfect slaty cleavage transverse to the stratification; but other parts of it are of a coarse mechanical texture. To the next inferior group he gave the name of *Middle Cambrian.* It composes all the higher mountains of Caernarvonshire and Merionethshire, and abounds in fine roofing slate, alternating with, and apparently passing into, irregularly interstratified masses of porphyry. Some portions of it are coarse and mechanical, and it contains (for example, the top of Snowdon,) a few organic remains, and a few examples of highly calcareous slates, but no continuous beds of limestone. The same group, with the same mineral structure, and in the same position, but without organic remains, is greatly developed in Cumberland. The *Lower Cambrian* group occupies the S. W. coast of Caernarvonshire, and a considerable portion of Anglesea: it consists chiefly of chlorite schist passing here and there into mica schist and slaty quartz rock, and contains subordinate masses of serpentine and white granular limestone. It contains no organic remains. Beneath the *Middle Cambrian* system (above described) there occurs in Cumberland (for example, Skiddaw Forest,) a great formation of dark glossy clayslate, without calcareous matter, and without organic remains. It passes in descending order into chiastolite slate, mica slate, hornblende slate, gneiss, &c. which rest immediately on granite. Whether the Lower Cambrian was to be placed on the exact parallel of these masses in Skiddaw Forest, the Professor did not determine.

This is but a faint sketch of an essay, at once elaborate and full of interest, and can only be received as a glimpse of the treasure to be expected in the great work on the subject, now preparing for the press by the learned authors. The proofs of the correctness of the divisions proposed were strong, particularly the very striking one, that fossils found in the caradoc beds and those above them are not found below the caradoc, and that the calymene blumenbachii, and asaphus caudatus, are neither found in the caradoc nor in the beds below.

Mr. MURCHISON considers the greywacke to commence truly below the Llandeilo flags. He mentioned also many curious facts, such as alternations of traprocks and sandstone, singular overthrowings of the shale, and the remarkable circumstance that the Wenlock limestone, which can be traced 120 miles underlying the Ludlow, is yet occasionally thrown over it by convulsions.

Mr. SEDGWICK explained the mode of connecting Mr. Murchison's researches with his own, so as to form one general system. He pointed out also the limit, as at present known, of fossils, none having been hitherto discovered in the lower Cambrian schists, and remarked in reviewing the general phenomena, that geological epochs were not effected by shocks, but like every thing in nature, were under the dominion of the usual laws of causation.

Mr. GREENOUGH took a general review of the matter brought forward by Professor Sedgwick and Mr. Murchison, and whilst he highly applauded the discriminating talent displayed by both, he was inclined to think that such subdivisions can only be expected to have a local application; at the same time, he thought they might be traced in Spain, in the north of Europe, and perhaps in America. He then alluded to many points of very great interest, and in reference to the opinion that certain crystalline stratified rocks are rocks altered by heat, he observed that the top of Ben Nevis, Sca Fell, Cader Idris, and

many of the greater eminences of Europe agree in character with rocks, so called altered. He concluded by stating, that though the scale of his geological map of England was not sufficiently large to admit of the representation of the minute subdivisions proposed by Professor Sedgwick and Mr. Murchison; he had long possessed information of the existence of marked lines of separation, and was far from considering the whole space described by them as occupied by one homogeneous formation.

Mr. MURCHISON feeling his views confirmed by the remarks of Mr. Greenough, said, that it was a point of gratification and pride to him to add to, or assist in perfecting the great geological map of England, which had hitherto thrown, and would still continue to throw light on the path of the geologist. Indeed, by that work, Mr. Greenough had earned the gratitude of all English geologists, and established a claim to be looked upon as one of the surest pillars of the science in this country.

Professor PHILLIPS pointed out the great difficulties which must attend the separation of the lower schistose rocks where fossils are wanting, and doubted whether all the British stratified rocks have yet, as a system, been made known. He then touched on those parts of Mr. Murchison's observations, which referred to organic remains, explaining the gradual diminution in number and variety of organic bodies in descending to the lower strata until they entirely disappear; but at the same time, without exhibiting any inferiority of structure in the older animal creation to that of the newer. The distribution of various organic bodies is also very variable; for example, the genus terebratula is still numbered amongst existing genera, and is found fossil in the oldest fossiliferous rocks, Spirifer extends from the Lias to the carboniferous limestone, Producta from the carboniferous limestone downwards, Orbicula now exists, and occurs in the Silurian system. It is, therefore, Mr. Phillips remarked, not by any single genus, but by a combination of co-existing genera that strata must be identified.

Dr. DAUBENY came from the Chemical Section to request the members of the Geological Section, as cultivators of a collateral science, to aid him in his endeavours to form a correct and classified list of the mineral waters of Europe. This he had undertaken at the desire of the Association, and he hoped every one who heard him would contribute any knowledge he might chance to possess either of the localities or nature of such waters.

Dr. JACOB read a paper on certain fossil polyparia found in alluvial deposits in the vicinity of limestone hills.

The fossils alluded to are found deeply embedded in a stiff clay which lies to a great depthon the sides of the limestone hills, called Dunamace range in the Queen's county, the situation is particularly described, to elicit descriptions of the locality of similar productions in other situations. The condition of these organic remains, although not now first noticed, Dr. Jacob considers highly interesting and well worthy of more attention than has been hitherto paid to them by geologists, affording, as they do, evidence of successive chemical changes in composition, calculated to elucidate the obscure subject of the envelopment of organic fossils. The coral is siliceous and embedded in a matrix of limestone, much of which has been removed by some solvent, leaving the animal product in a fine state of preservation exposed. The original carbonate of lime of animal origin, appears to have been removed and silex substituted for it, so exactly that the most delicate lineaments of the fossil are preserved; this again appears to have been embedded in the carbonate of lime, constituting the present limestone matrix, which matrix has since been partially removed, leaving the siliceous coral projecting from the block. This dissection of the fossil, Dr. Jacob considers to have taken place while the fragment lay in the soil protected from the atmosphere, but exposed to the solvent effects of water and carbonic acid. Some doubts are entertained as to these fossils being separated from the rocks in the vicinity, as they are not found except sparingly in the quarries; in which case they must be derived from some more distant source, and constitute part of a great mass of detritus.

Professor PHILLIPS described a tertiary deposit recently laid open to a considerable extent on the coast of Yorkshire. Mr. Greenough had surmised the possibility of finding it at Burlington Harbour, but until recently it had remained concealed. It is now quite distinct, and consists

of a green sandy deposit, resting on clay containing shells. There are also bones of fishes, and of cephalopodous mollusca. Of 55 species of shells, only ten are identical with either crag or recent species—four being crag, and five or six recent species. Mr. Phillips considers the deposit intermediate between the London clay and the Bordeaux basin. He then read a letter from Mr. Lyell, partly on the subject of this deposit, a portion of which he had seen many years ago, and stating his conviction that the crag would ultimately admit of division into two deposits of distinct geological age.

Mr. Griffiths now addressed the Section, and with a few eloquent and impressive remarks closed the business of a meeting which had been attended with the best results—the interest of a crowded audience having been kept alive from the beginning to the end, by a union of deep research, sound reasoning, and philosophical speculation of the highest order.

SECTION D.—ZOOLOGY AND BOTANY.

It was expected that the zoological and botanical Section would hold their meeting for the day in the Lecture-room attached to the Gardens and that it would be opened by a communication from the celebrated Professor Agassiz, on the classification of the *mammalia* tribe, but unfortunately, owing to the Professor's manifold engagements, he was unable to prepare himself. On the following day, however, there was a regular meeting of the Section, when he made some very interesting observations on the principles of animal classification in general, and particularly on that of the *mammalia*, and on the connection which exists between the natural orders of the different classes in the animal kingdom and the order of fossil succession in the different beds of the crust of the earth. As these observations were made in French, in giving an outline we shall adopt the scientific terms of that language as used by M. Agassiz. He observed that the various systems which have been applied to the distribution of organic bodies, in order to facilitate their study, have always presented great defects when they have not had for their basis the study of the interior organization of those bodies and of their relation to the exterior creation which surrounds them. Comparative anatomy has furnished facts most important in the classification of animals; yet it is undeniable that diversities of organization exclusively considered, would lead to very artificial divisions, because there are yet no established principles by which the importance of these divisions can be accurately estimated. The philosophers of nature perceiving this void, have supposed man to be the type of creation, and have regarded the rest of the animal kingdom as an individualized manifestation, more or less perfect of different parts of the human organs. Oken, carrying out this theory, has established as many classes in the animal kingdom as there are systems of organs in man, and has regarded the different classes of animals as living representatives of each system. His divisions, it is true, coincide in general with those before laid down, from reasoning exclusively anatomical, and they have the same defects; but they have also the merit of following in every class, parallels and analogies founded on one principle, that of the *progressive development of the animal organization.* These analogies are often advanced with too much confidence, and are frequently exaggerated and erroneous; however, they will doubtless lead to a classification, more and more perfect, for it is evident that now, by establishing on the smallest diversities, new families, and new orders, the natural affinities which unite the great divisions of the animal kingdom are more and more effaced. These considerations and others, too numerous to be detailed in this place, have induced M. Agassiz to endeavour to bring together, by means of their common characters, the natural families which have been established in the class of mammifères. The cétacés, whose whole organization is so peculiar, constitute the *first* of a distinct order. The *second order*, characterized by the absence of genuine canines, acting as such, and by an alimentary process essentially vegetable, comprehend the *tachydermes*, which approximate to the cétacés by the genus dinotherium, the ruminans, the edentés, the rongeurs, and the herbivorous marsupiaux. *The third order* has canine teeth an *animal* alimentary process, and is connected with the preceding by the didelphes; it comprehends the insectivores, the chiropteres, the carnassiers, and the quadrumanes. *The fourth order* comprehends the human species alone. This classification coincides in a singular manner with the order of succession of the fossil mammifères, which now occupy great spaces, that were till this discovery, blanks in our tables, and which have thus disclosed tousan order of things in times past of which we could form no idea, but through the means of fossil remains. Under this point of view much must remain to be done, till the connexions

which exist between the organization of animals, and their succession in the series of created things shall have been determined in a manner as satisfactory as in the class of fishes.

A number of gentlemen attached to the study of plants, set out on a botanical excursion to the Hill of Howth, with Mr. Mackay, Superintendent of the College Botanic Garden. Under his direction they were gratified with a sight of several of the rare plants of that interesting place in their native habitats, particularly the following:—*Statice spathulata* (Hooker), in full flower, growing in the greatest abundance, on the strand near Baldoyle, along with the more common *Statice Limomium*. On the cliffs on the south side of Howth they had an opportunity of seeing *Atriplex portulacoides*, *Limbarda tricuspis*, *Asplenium marinum*, *Aster Tripolium*, *Crithmum maritimum*, and other curious plants. On the ascent from the west side they found the little rush called *Isolepis Savii*, Welsh specimens of which had, a few days before, been shown at the Natural History section by Mr. Babington, of Cambridge, who formed one of the party on this occasion. This Howth plant had probably hitherto been mistaken for the *Isolepis setacea*, which it much resembles. Besides the gentlemen mentioned, the following were of the party: Dr. Graham, Professor of Botany at Edinburgh; Mr. Allan Cunningham, the Australian traveller; Mr. Don, of the Linnean Society; Mr. Richard Taylor, of London; and Mr. J. Meadows Taylor, Dr. Hahn, of Gottingen; Dr. Lloyd, of Leamington; Dr. Neil, of Edinburgh; Mr. Christy, of Clapham; Mr. Parker, of Liverpool; Mr. Waterhouse, Curator of the Liverpool Museum; Mr. Lingwood, of Cambridge; Dr. Ramage, of Edinburgh; Mr. Nuttal, of Tittour, in Wicklow; Mr. Forest, of London; and Mr. Fraser of Dublin.

SECTION E.—ANATOMY AND MEDICINE.

The interest created by the meetings of this Section appeared to increase every day. This day the proceedings opened by a paper from Dr. O'Beirne, explanatory of his peculiar views on the functions and diseases of the intestinal canal; and giving some additional cases in corroboration of the accuracy of his published work.

Doctor OSBORNE considered the effect of cold, as applied to the lungs, the stomach, and the skin. He showed that there is a provision of nature, by which the air in respiration, before it arrives at the ultimate ramifications of the bronchial tubes is heated to such a degree, that even in the coldest climates the lungs are protected against its effects. When, however, in certain diseases, in consequence of deficiency of nervous energy, the heat of the surfaces of the body is not maintained, then the air arrives in a cold state at the air vesicles of the lungs, the result of which is torpidity of circulation through their capillaries, stagnation, and death. To this he ascribes the frequent cases of sudden death occurring in chronic *bronchitis* during the night when the temperature of the apartment has not been secured against the vicissitudes to which our climate is so liable. The stomach appears to enjoy a peculiar insensibility with regard to temperature. Thus an individual sometimes takes tea or other hot beverages at a temperature of 140 or upwards, and ice at 2, without cold or heat being perceived in the stomach. Those sensations being only felt in the passages to it. When however ice is taken, thirst is frequently experienced; and when large draughts of cold water are taken by a person overheated, and under the depressing influences of fatigue, then gastritis is a common result. Those occurrences, Dr. Osborne illustrated by observations on the effects of cold as seen in the exterior of the body, and by a comparison of these with the experiments relating to inflammation made by Dr. Alison, and reported by him at the last meeting of the Association.

By far the most important effect of cold is, however, that which it exerts on the body when applied to the skin. Of fifty-seven patients in Sir Patrick's Dunn's Hospital, thirty-four could distinctly refer to cold applied in the following manner;—in twelve, wet clothes; five, damp feet; three, bathing; and fourteen, cold air when heated. The reason that meteorology has contributed so little to our knowledge—of the influence of the atmosphere on health or disease, is that no means have been adopted *to estimate its cooling power with reference to ourselves*. In order to accomplish this object, Dr. Osborne employed an instrument which he proposed to call a *psychometer* or measurer of refrigeration. It is simply a spirit thermometer heated to 90 (that being the average of temperature of the skin) and exposed to the air under any circumstances in which it is desired

to try it. It is then inferred that the cooling power is inversely as the time required to reduce it to 80°. By Dr. Osborne's observations it appeared that the cooling effect of a breeze at 70, is to that of the air at rest at the same temperature as 5 to 1; and secondly, that at the temperature 62, the cooling effect produced by fanning is nearly as 3 to 1. From the application of this instrument it is not too much to expect that much light will be thrown on the unhealthy nature of the climates of the West Indies, and of the coast of Africa, with respect to which all the observations made with the instruments hitherto in use, have completely failed, and which is evidently dependant on the sea and land breezes.

It appeared that the refrigerating power of water at rest at 70 was to air of the same temperature as 14 to 1, and that the refrigerating power of the water was increased by agitation in the ratio of 24 to 15. This corroborates what is well known to swimmers of the benumbing effects of moving through water.

In order to ascertain the extent of refrigeration produced by wearing damp clothes, Dr. Osborne compared the time taken in cooling in air at rest at 68, by the instrument covered in dry cotton wool, and by the same in a damp state, and found the refrigeration sustained in the latter case, to be to that in the former, nearly as 5 to 1, a proportion which would be much greater if the experiment were made in the open air.

The Committee of the Section have resolved that Dr. Osborne's paper shall be submitted to the consideration of Committees in Dublin, Edinburgh and London, appointed by them for that purpose, who are to report on it to the next meeting of the Association.

Doctor HUTTON read an account of a peculiar case of malformation of the brain, attended with idiocy, and congenital dislocation of the hip joint. The case was considered one of the most important, both in a physiological and pathological point of view, which had been brought before the section. It was that of an idiot named John North, aged 31, who died in the Richmond Hospital of a diffuse inflammation of the mucous and sub-mucous tissues of the pharynx and larynx, terminating in purulent infiltration and extensive bronchitis, and in whose body was discovered, after death, a remarkable deficiency of development in the right hemisphere of the brain, together with an original or congenital dislocation of the left hip joint, permanent flexion and pronation of the left hand, and atrophy of these members. He observed, that he would confine his observations to the instances of deficient and perverted development. The head could not be said to be deformed externally, but the brain was small and the osseous case much thickened, particularly in the frontal region. Its fracture here was granular, there was no distinction between the tables and diploe, its inner surface was rough, and the dura mater closely adherent. A great part of the right hemisphere was deficient, and a serous cyst filled with limpid fluid, five inches in length, and between two and three in its transverse diameter, occupied the hiatus. Here Dr. Hutton presented two drawings, illustrative of his observations—one presents the cyst in its distended state, the other in its collapse. He then entered into a minute and scientific description of the case, which, however, we could not well explain without giving the drawings; and as we understand that Dr. H. himself will shortly publish a correct statement in a detailed form, we would not venture on an abridgment. He observed, in conclusion, that the patient seemed to have very few ideas, and those of the simplest kind, principally connected with his sensations. He apprehended some ideas readily, but could not give them utterance, had little use of language, and articulated indistinctly. He had strong local and personal attachments, was very fond of his nurse and attendants, and frequently asked leave to go and see them while in hospital. He was inoffensive in his manners, well conducted, and of a cheerful disposition. He was not indifferent to money, and asked for his penny like others. During his illness, he frequently cried out to his medical attendant, "make me live, make me live;" and referred to the throat as the seat of his disease. The whole brain was smaller than natural; so was the cerebellum, but it was perfect in all its parts. No difference could be observed between the cerebral arteries on the sound and diseased side of the brain. He had a slight degree of strabismus, and it was thought by the nurse, that he did not see as well with the left eye as the right. He was thirty-one years of age at the time of his death, and has been always an idiot. He was a foundling, and nothing was known concerning his parents.

Dr. HARRISON considered Dr. Hutton fully entitled to the best thanks of the meeting, for the extraordi-

nary ability and diligence which he had exhibited in working out the details of a case which had been only a few days in his possession.

Dr. HANDYSIDE, of Edinburgh, stated a case of a similar nature, corroborating the views, and establishing the importance of the case described by Mr. Hutton.

Surgeon ADAMS read a paper on aneurism by anastomosis. He described the different kinds of this singular affection, and illustrated them by numerous rare and beautiful drawings, taken from cases which had occurred in this city, both in his practice and in that of other eminent surgeons. He observed that it was Mr. J. Bell who had the merit of first directing the attention of the profession to this disease. Many were acquainted with it before his work appeared; the true arterial form of it, however, was generally confounded with true aneurism, and the operations, which were performed in ignorance of its nature, were imperfect and unsuccessful. It was pleasing to reflect on the good which Mr. Bell had effected; but still it must be acknowledged that our knowledge of the nature, form, and anatomical characters of this affection were limited, and he did not think he was occupying the time of the section unnecessarily in attempting to throw additional light on the subject. Having brought forward a number of cases in proof, he took an elaborate review of the different accounts given of aneurism by anastomosis, and stated that the structure of these tumours seems to be analagous to the erectile tissues. One of the best modes of ascertaining their structure had been adopted by the late Mr. Shekleton; this gentleman having injected the part through one of the largest vessels, and then by placing it in an acid solution, corroded its animal parts, leaving the vessels entire. A magnified drawing of this preparation was exhibited to the meeting, shewing the retiform arrangement of the vessels, their tortuosity, and their abrupt enlargements at certain spots, and contractions at others. Mr. Adams concluded his elaborate paper by some interesting observations on the tortuosity of arteries. This paper created great interest, and a conversation on the subject of it followed, in which many curious and important facts were elicited. The Surgeon-General, Surgeon Read, President of the Royal College of Surgeons, Professor Harrison, Dr. Handyside, of Edinburgh, Dr. Granville of London, Dr. Houston, and others, joined in the discussion.

Dr. HAWKINS, of London, introduced to the notice of the Section Mr. Harrington's patent electrizer, which he described as being useful in the cure of certain painful affections of the body. It is in the form of a plaster, consisting of two parts of powdered zinc, and one of silver, stuck together by a solution of five parts of shalac, and one of borax in hot water, spread thinly on linen.

Mr. SNOW HARRIS exhibited the bones of the hip joint of the celebrated comedian, Matthews, who was supposed to have sustained a fracture of the neck of the thigh bone, by a fall out of a gig many years before his death. Mr. Matthews had walked after the accident, but subsequently after a long confinement to bed, the leg had become much shortened.

An interesting discussion as to the real nature of the lesion in the bone followed, in which Mr. Harris, the two vice-presidents, Professor Colles, and the Surgeon-General, Dr. Grenville, Professor Harrisson, Surgeon Adams, Surgeon M'Dowel, Surgeon Hargrave and others joined. It appeared to be the more general opinion, that the specimen presented was an instance of the disease termed *morbus coxæ senilis*, of which some specimens were exhibited of very analogous character, rather than one of fracture of the neck of the thigh bone, in which reunion of the broken bones had been effected. In consequence of the difference of opinion, it was finally arranged, that a committee should be appointed to examine into the nature of the case, which, if it proved to be an instance of reunited fracture of the neck of the femur, should be preserved as a rare and almost unique preparation.

Dr. HANDYSIDE of Edinburgh, gave an abstract of a paper which he held in his hand, containing numerous and important observations and experiments on the respective powers of the lymphatics, lacteals, and veins, in carrying on the phenomena of absorption from the surfaces and integral structures of the body. Dr. H. gave a clear and eloquent summary of the conclusions he had arrived at, but in consequence of the lateness of the hour did not wish to detain the section by an attempt to read the whole paper, and referred the examination of its merits to the consideration of the committee. From the various reasonings advanced and experiments detailed in this paper, the author considered it proved, that the absorption of foreign matters, occurring from the interstices and surfaces of the body, occurs solely through the channel of the venous system.

It was here announced that the business of the section had come to a close, upon which

Professor HARRISON rose, and said—Mr. President, in coming thus to the termination of our labours, I cannot but avail myself of this opportunity of giving expression to the feelings of gratitude and respect, which I am sure I entertain in common with all my professional brethren in this city, towards the distinguished and enlightened individuals who have brought the British Association to our shores, and have themselves come amongst us to shed a lustre on the science which is beginning to dawn amongst us in this country, and to reciprocate in the pleasures and advantages which the cultivation of truly scientific objects yields. But, Mr. President, this is not the only good effect which will come out of this happy, this fortunate intercourse with the great men whom I see around me. I foresee a farther, a more substantial good likely to flow from it—an amalgamation of feelings and anxieties for the common good of our united kingdom, such as no parliamentary enactment, whether of the most rigorous or the most liberal character, could ever accomplish. Moreover, I look upon this occasion—this visit of strangers of such distinction, as one of the most important that has ever occurred towards raising the character of our profession in this country, and placing it in the sphere which it is destined to hold among the liberal and useful sciences. Sir, I shall conclude by moving a vote of hearty thanks to those medical gentlemen who have on this occasion come to our city, and who, by their scientific communications and great attention at the meetings of this section, have contributed to render it one of the most creditable and instructive which the British Association can boast of.

Dr. GRAVES rose, and said—Sir, there never has been an act of my life of which I shall feel more proud than in being allowed the honour of seconding Professor Harrison's motion. Our obligations to these gentlemen are greater than it is in my power to express. Our labours in the field of science would have been fruitless without their presence, whereas now they have been crowned with success. There is none of us who will not acknowledge the delight—the improvement, and even the elevation of character which we have derived from their visit, and from their communications. Sir, we have great encouragement from the grand results of this meeting to persevere in our endeavours to make the medical section of the British Association equal in utility and rank to the other sections. I say it, Sir, but without jealousy to the other sections, that we have not hitherto preserved our level with them—that we have been in the shade; and seeing now what a little exertion on our part is capable of effecting, let us have energy in future—let us, to use a familiar phrase, beat up for recruits, and bring our forces to bear in our cause. We have experienced the benefit of the assistance of strangers, and we pledge ourselves to be at our post at the next year's assembly, to endeavour to make a return for the honour and the benefit which have on this occasion been conferred on us, and on the common cause which it is our duty and interest to support.

The motion was carried with acclamation.

It was then moved that the President do leave the chair, and that Dr. Broughton be called thereto; upon which

Professor ALISON rose, and, in the name of the non-resident medical gentlemen of the Association, expressed in the warmest and most eloquent terms, the great gratification and pride which he experienced at so happy, so fruitful, and so creditable a termination to the labours of the medical section on this occasion. At no former meeting had there been so much of valuable matter communicated; so full, so assiduous an attendance on the part of the members, or so much of scientific taste displayed. The proceedings of the section would be found highly creditable to the Association, and useful to the profession at large. Professor Alison spoke in the most glowing language of the hospitality, the kindness, the attention which had been shown to all strangers, and to himself in particular, and assured the meeting that his preconceived notions of Irish hospitality were far more than realised by the result of his experience in this, his first visit to Ireland. Professor Alison then stated that he could not take his leave of the country without putting on record, in the proceedings of the Association, his own and his fellow-strangers' expression of their gratitude for the kindness shown them, and their high sense of the enlightened and scientific character of the profession in Ireland, as well as their anxiety to give information on any matter when required, in a style of gentlemanlike spirit which could not be surpassed. He was in a moment seconded by Dr. Granville, of London, who said,

That though he had arrived at a period of life when it might be supposed his feelings were blunted,

that at parting, as now the time had arrived, he could not utter the real sentiments of his heart as he could wish, because he felt more than he could say; but that he drew on his friend's (Dr. Alison) observations as a prototype of what he would say if he could.

A resolution of thanks to the President was then put and carried with acclamation.

SECTION F.—STATISTICS.

Mr. BABBAGE read an abstract of the Ordnance Survey of the parish of Templemore and city of Londonderry, a copy of which had been presented to each section by command of the Lord Lieutenant. He declared, that he considered it a perfect model of statistical science, and that the gentlemen by whom it had been compiled, had established a strong claim to the admiration and gratitude of their countrymen.

Colonel Sykes, the Rev. E. G. Stanley, and Dr. Taylor, joined in eulogizing this excellent work, after which the thanks of the section were voted to the Lord Lieutenant, for having sent copies of the volume to the Association.

Dr. Jones read a long and interesting paper on the condition of the lunatic asylums in Ireland.

Two papers, presented by Mr. Fox, on the punishment of death in Norway and Belgium, were read, tending to prove that crimes of violence diminished as executions became less frequent. Here the labours of the section terminated.*

DINNER.

Upwards of one hundred and fifty gentlemen, members of the British Association, sat down to dinner at the ordinary at Morrison's this day. Sir Thomas Brisbane, Bart., presided; he was supported on his right by Professor Hamilton, Mr. Murchison, &c.; on his left by Baron Foster, Doctor Baily, President of the Astronomical Society of London, &c. Several other distinguished members of the Association were of the party. After the cloth was drawn the toast—

"The King," was drank with three times three, and great applause.

"The President of the British Association, the Rev. Dr. Lloyd," was next drank with acclamation.

Professor HAMILTON having been called upon, made some very happy observations, in the course of which he mentioned a circumstance reflecting great credit on the learned Provost of our University—that at the first meeting of the Association, Doctor Lloyd was the only representative present of any of the Universities in Great Britain.

The PRESIDENT next gave "The distinguished Foreigners who visited this country on the present occasion." Drank with all the honors.

The Baron DE TOLLY rose to acknowledge the toast amid loud applause. One of the company cried out in reference to the distinguished Baron, "*Tam Marti quam Mercurio.*" The Baron expressed himself in French, as deeply sensible of the honor, and that he would ever hold in remembrance this mark of kindness. He concluded by proposing "The health of Sir Thomas Brisbane," which was enthusiastically responded to by all the company standing.

Sir THOMAS BRISBANE, in returning thanks for the compliment paid him, took occasion to say, that he had been at all the meetings of the British Association, from the first which took place in York until the present, and he felt bound to say, that the Meeting in Dublin was by far the most brilliant of any yet held.—(cheers.)

The President next proposed—"The health of Mr. Arthur Guinness and the commercial interests of Dublin." Drank with all the honours.

Mr. A. GUINNESS expressed his grateful sense of the compliment paid to him; if any thing could induce him to exert himself more than he had done to advance the commercial interests of Dublin, it would be the recollection of their kindness. With the permission of the chair, he would beg to propose "The healths of the English and Scotch gentlemen who honoured Dublin with their presence on this most important and interesting occasion.

[Loud cheering followed the announcement of this toast.]

Dr. BAILY, of London, having briefly expressed his sense of the compliment to himself and friends, the company retired.

* In a former page we acknowledged our obligations to "the Atheneum," for a large proportion of the two first days of the Mathematical Section; we however, feel it is but justice to the talented individual who reported the proceedings for that paper, now to state, that we have adopted some other portions of his Report, considering them superior to the abstracts which we had obtained from other quarters.

EVENING MEETING AT THE ROTUNDA.

The Round Room of the Rotunda was crowded to excess, and the proceedings of the evening were listened to with great interest and attention. The President of the Association, having taken the chair, called on the Presidents of the Sections for their reports.

Dr. ROMNEY ROBINSON presented the report of the Physical Section.

Dr. LARDNER presented the report of the subsection of Mechanical Science applied to the Arts. He said that the plan of the subsection had been tried at Edinburgh; there seemed to be some unwillingness to continue it, but here also they had been obliged to adopt the same arrangement.

Dr. APJOHN reported from the Chemical Section, and

Mr. GRIFFITH from the Geological.

Mr. BABBAGE, in presenting the report of the Statistical Section mentioned, that as the ordnance survey of the county of Londonderry had formed a leading subject of discussion in the section, he would take that opportunity of giving the following analysis of the arrangment adopted in the work. The first section, in its division under the head of natural features and natural history, describes all that nature has done for the district. The second section describes the works of art, modern and ancient; tracing back the present buildings to those they have successively replaced, from the modern church to the ancient cromlech. The third section describes the people and their institutions, beginning with their early history, and gradual advancement to the present condition of their social and productive state. Mr. Babbage proceeded to express the strong opinion of the section respecting the advantages which must result to statistical science, from the example of a work so minute in its details, and so lucid in its arrangement; and enlarged on the beneficial effects which the continuation of the work in the same enlightened spirit would produce to Ireland. Mr. Babbage closed his remarks, by urging, that a work of this nature was so necessary, it would be cheaply purchased at a considerable additional cost; but it was doubly gratifying to know that when combined with the maps already executing by the Ordnance Survey, the additional expense was immaterial.

Professor GRAHAM, from the Botanical Section, in mentioning a classification of Irish plants, presented by Mr. Mackay, took occasion to say, that there was one plant of Irish growth, which he at the section had neglected to mention: it was a singular and beautiful specimen; he alluded to that open hearted, open handed, warm hospitality which he, in common with all visitors, had experienced since their arrival in Ireland—(cheers.) He hoped it was not a *genus* peculiar to Ireland—(cheers and laughter)—but it must have struck every phlegmatic Scotchman the hospitality they experienced in Ireland. The learned Professor proceeded to speak of his impression, as well as that of the rest of his section, that there was one chain of beings, continuous, but tortuous,—branching in various ways,—broken nowhere but between th ereator and his works. All man could hope for, as the highest link of that chain, was another and a better world, being the link between the creatures of immortality and the creatures of time. This link, though rusted and stained, might be made bright and polished as it had been. Then all, united by bonds of love, and strengthened by faith, would not lose their last hope—a blessed immortality—(great applause.)

Mr. HARRISON presented the report of the Medical Section. He said, in conclusion, that so much talent and research had been displayed in this section, that he sometimes almost thought that disease had obligingly suspended its operations to permit so many medical men to be present, without injury to the health of the community. He spoke very highly of the assistance they had received from the talent of their medical brethren of Edinburgh.

After the proceedings of the Sectional Meetings had been read, Mr. Babbage explained a very ingenious speculation which had arisen in his mind from a consideration of the concentric rings of growth of trees. He stated that he had been led by an accidental circumstance to the contemplation of a subject of so simple and definite a nature, that it could be grasped by any ordinary understanding, and might be made a matter of instructive and profitable research by many of the intelligent individuals then present. The absolute establishment of a new step in any branch of knowledge, he did not think of so much intrinsic value as the train of reasoning which led to it; the mind dwelt upon the one as an axiom, while the contemplation of the many circumstances which were found necessary to sustain or confirm it, opened a wide field for the exercise of the mental faculties, and supplied them during the investigation with much valuable in-

formation. The possibility of ascertaining the age of certain trees by the circles or layers of the wood, had been discussed and proved before one of the Sections on the day previously. This subject had reference to the one upon which he was about to treat:—Sitting one evening with a friend, under the shade of an old ash tree, it became the subject of their conversation; and after taking into consideration some of the circumstances affecting the growth of trees, the idea forcibly struck him that the superior width of one layer or circle of the wood, as compared with another, might, by analogy, be made the means of determining the period at which any specimen (fossil or ligneous) which might be discovered, existed. [He submitted a diagram representing a section of wood, and showing the annual circles of various magnitudes, equivalent to the luxuriance and unproductiveness of the seasons in which they were produced; in some cases following each other in uniformity of size and appearance for a series of years, and then presenting one or more circles of unusual size; in others alternating in groups of good and inferior vegetation.] Referring to the diagram, he observed, that a fertile season, by affording abundant nourishment to the tree, would be attended with an increased thickness of the ring of the year, and an unfavourable season by a diminished thickness. Mr. Babbage therefore conceives, that if in the cross section of the trunk of any tree a series of thick rings can be traced, occurring after intervals of three, four, five, or more thin or starved rings, a record is obtained of the recurrence of certain favourable seasons in a similar order. Now, if in the section of another tree the same thick rings appear, having the same numbers of thin rings between them, so as to constitute the same series, the second tree may be considered to have been growing cotemporaneously with the first—each exhibiting evidence of the same order of seasons. Again, if a distinct series of thick and thin rings can be made out near the centre (or commencement of growth) of a very old oak tree, just cut down, and exhibiting in all 500 rings; and on examination of a stump of another oak, taken from a neighbouring peat moss, the same series of thick and thin rings, is discoverable near the circumference or later portion of growth, it may be inferred that the last years of the peat oak were coeval with the first of the recent oak—the epoch of birth of the first being known by a summation of the number of rings posterior to the standard series in the recent oak, and of those prior to the said standard set in the peat oak. By taking another series near the centre of the peat oak, might be connected in like manner, by comparison, with the same series, near the circumference of a still older peat tree; and so on until, as Mr. Babbage supposes, the trees of the peat might be actually connected with some of those imbedded in solid strata, and consequently the epoch of the latter discovered. To unite this series with some fixed point was what he wished. It might be difficult to do so, but it was by no means impossible; and he called upon those around him to second him with their acquired experience and future observation. He would relate a circumstance, which, in addition to the proofs advanced in the botanical section yesterday, would scarcely leave a doubt as to the accuracy with which the age of a tree may be determined by the number of its annual rings. In one of the Cape Verd Islands there is an old (we believe cork) tree; three hundred years since some English travellers attracted by its apparent antiquity, carved their names on the bark, and after their return to England made a record of the transaction Recently a party had the curiosity to ascertain if any, and what vestige of the incisions remained, and on cutting their way into the tree found all the names in perfection, removed just 300 rings from the bark! On making an admeasurement of the trunk, and ascertaining the number of those rings in a given quantity, they calculated that the tree had existed upwards of 5000 years! Such is the ingenious speculation of Mr. Babbage; and it is highly characteristic of the acute and penetrating mind of its highly gifted author.

Professor SEDGWICK next addressed the meeting, commenting on the proceedings of the Geological Section, and drawing from them the more obvious general conclusions. The matter, indeed, brought forward at the Sectional Meetings had been so varied and full of interest, that no better theme could have been provided. In plain geology, the map of Mr. Griffith, and his illustrative remarks, had done much to connect the geology of Ireland with that of other countries; while it cannot be doubted, remarked the Professor, that the labours of more recent observers—such as the officers of the Ordnance Survey, Mr. Bryce, Mr. M'Adam, and others, will

throw further light on this subject, and result in a still more accurate and perfect map. On the joint labours of himself and Mr. Murchison, in penetrating the mysteries of the older stratified rocks, Mr. Sedgwick touched but lightly, though he fully explained the reasons which had induced him and Mr. Murchison to introduce new names, in place of one which had assumed an almost Protean meaning, signifying at once every thing and nothing. In this way the terms *Silurian* and *Cambrian* have been proposed to replace that truly indefinite name, *Transition*, or its equally vague partner, *Greywacke;* and being simply founded on historical or local associations, they are the less calculated to mislead. The value of these researches will be appreciated by all who having once turned a longing and despairing eye on what was then a *terra incognita*, can now look with pleasure on a known country; which, though just discovered, already exhibits every symptom of regularity and improvement. The Professor next dwelt with great force on the advantages which had attended the union of geology with other sciences, each shedding a light on the other; and this not merely as regarded the more obvious combination of zoology and botany, but also as it referred to that connection with the physical sciences which had been made manifest by the researches of Fourier and Poisson, and had been so well pointed out that day by Professor Whewell. In truth, whether the phenomena of geology are to be ascribed to central heat, to magnetic agency, or to any other proximate cause, still are they the results of those general and primary laws of matter which bind together the whole system of the universe, and retain it in harmonious order. But the highest bursts of the Professor's eloquence were called forth when he passed in review the labours of Professor Phillips and M. Agassiz, and gazed, as it were, on the bright and fascinating pages of the early natural history of the world which they had assisted to unfold. Now indeed the skill of the zoologist is an essential, an indispensable guide to the geologist; and in like manner the geologist may claim the reciprocal merit of having provided materials for perfecting the knowledge of organic beings, by supplying those links which before seemed inexplicable gaps in the order of creation. No more can it be said that nature began by feeling its way in simple forms, and then created more complex; or that it left the first crude efforts of its hand to be matured by external agencies or circumstances; for now examples are every where found, in the older strata, of organizations as complex and as perfect as those of the existing races of living beings, and doubtless equally fitted for supporting animal life. Geology, indeed, had called "monsters from the vasty deep," but it had exercised over them the control of philosophical reasoning, and charmed them into order. The uses to which, in geology, this new knowledge has been turned, are now too well known to require elucidation or remark; and though Professor Phillips has rightly urged the necessity of caution in their use, as guides to a knowledge of strata, it can scarcely be doubted, that judiciously combined, they afford a clue which may be used with success and certainty.

This is the case especially with fishes, the organization of which, from its greater refinement, is more susceptible to any change which may occur in the condition of the earth's surface; and it is, therefore, by their use, illustrated as they are and will be by the profound science and acute discrimination of an Agassiz, that the geologist may hope to thread his way through the most obscure and difficult paths of his science. How justly proud, indeed, should the Association be, that they have been enabled to facilitate the researches of so eminent an ichthyologist, pointed out by Cuvier as the fittest for the task he has undertaken, by applying a portion of their funds towards the plates of his great work on fossil fishes! The Wollaston Medal had already been conferred as a justly merited distinction upon M. Agassiz; and it was gratifying now to see him amongst those illustrious foreigners who had come to attend this meeting, as they could at once express their warm applause of his past labours, and their confident expectations of his future success. The Professor concluded by an eloquent address to the feelings of the meeting, eulogizing the good spirit and harmony which had characterized all its proceedings; and expressing a hope that much of the happiness which had been shed over the meeting by the kind and hospitable attentions of the native members, would long continue to linger behind when they had all separated; and that Englishmen and Irishmen would at all times be found united in the same great cause—the advancement of human knowledge, and the amelioration of mankind.

Before the meeting separated, Mr. TURNER begged leave to observe, that Sir John Tobin would not leave in his steam-vessel until six o'clock on Tuesday morning.

MEETINGS OF THE ASSOCIATION, SATURDAY, AUG. 15.

MEETING IN THE ROTUNDA.

The chair was not taken until three o'clock: the officers and leading members of the Association having been occupied until that hour at the Meeting of the General Committee. THE PROVOST having taken the chair,

Mr. VERNON HARCOURT apologised for the length of time that the meeting had been detained, but it would perhaps be gratifying to them to know that the cause of the delay had been the number of invitations which the Association had received for their next meeting. They had invitations from Manchester, Liverpool, Newcastle, Bristol, and many other places, all having strong claims to be selected as the next place of meeting; many of them towns of great commercial and manufacturing importance. In this perplexity of divided claims, they had determined that priority of invitation should weigh; they had decided that the next meeting should be held at Bristol, to which they had been invited first by the scientific bodies of that town, and which besides afforded facilities of intercourse with the south of England, from which all former places of meeting had been remote. There was a difficulty in the appointment of officers; it was very uncertain whether those persons whom they might now select as fit to hold the distinguished offices of President and Vice-Presidents could undertake the duties: they had accordingly left the nomination of those officers to the council. They had fixed on the second week of August as the period when their next meeting should be held in Bristol. It would be next his duty to state the sums which had been voted by the general committee.

Mathematics and Physics.—The Committee, after recommending the renewal of many former grants, proposed that small grants be given for constructing tables of refractive indices, and making organized observations of temperature:—

500*l.* for a duplicate reduction of the Astronomical Observations made at L'Ecole Militaire of Paris.
100*l.* for determining the constant of lunar notation.
100*l.* for observations on the temperature of the tide.
250*l* for continuing tidal observations in Liverpool and the Port of London.
100*l.* for the advancement of meteorology.
30*l.* for the continuation of Professor Wheatstone's experiments.
30*l.* for reducing to practice Dr. Jerrard's plan for solving equations of the fifth or higher degrees.

It was also recommended that the Association should petition the government to send an expedition to explore the Antarctic regions, and determine as accurately as possible the place of the south magnetic pole.

Chemistry.—That 20*l.* should be given to Mr. Johnston for completing his tables of chemical constants; and 30*l.* to Mr. Fairburn for experiments on the hot and cold blasts in iron-works.

Geology.—That 105*l.* should be granted for prosecuting researches into British Fossil Ichthyology; and that the former grants for determining the amount of sediment in rivers, and the relative levels of land and sea should be renewed.

Natural History.—That the Zoology and Botany of Ireland should be carefully investigated.

Medical Science.—That 50*l.* should be granted for researches into the absorbents; and 50*l.* for examining the sounds of the heart.

Statistics.—That E. Halsewell, Esq. be requested to prepare a tabular return of the inquests held during the last seven years in as many counties as possible; and further, to prepare a statistical report of Hanwell Lunatic Asylum. That the heads of inquiry into education issued by the Manchester Statistical Society, should be recommended to those who design to make similar inquiries.

These grants were very liberal, but the general committee found their funds large enough to justify them (cheers.) He deprecated every change in the plan of the society—a plan formed after the model of similar associations on the continent. At this meeting he had seen much of the working of the sections, and he was convinced that the division into sections was good. His own old researches had been all revived, by being present at the able observations of his friend Mr. Griffith. The sections were a means of promoting the grand object for which they met. The collection of eminent men from all countries was that on which their success must depend: thus they learned from masters of science, not only the matter, but the manner and spirit of their enquiries (hear, hear, and cheers.) But it was not in the delightful intercourse of assembling together generally to enjoy each other's society—it was not even in the kindness and hospitality with which every where they were met—and in no place had they met more than in the metropolis of Ireland—was not in these enjoyments, high as they were,

that they could find the interest sufficient to induce men to undertake long journeys—it must be in the prospect of meeting kindred spirits, and the moral sympathy of those devoted to the same object. It was most important that such an Association should exist, to afford facilities for the bringing forward of new discoveries; for the greatest genius might be depressed by the want of such facilities. He trusted he was not taking too great a liberty with Dr. Dalton, in referring to him as a remarkable instance of the good of this Association. There were many discoveries of that great philosopher which had been unknown until late years; and often had discoveries made by him been imputed to others until in the sectional meetings of this Association that great man had claimed them as his own (cheers.) It had been asked of Dr. Black, why he did not follow out some discoveries which he had made, but left it to Priestly and others to prosecute his labours, and give the results to the world. He (Dr. Black) confessed that he was aware of those results, but he feared to publish.—"I was afraid," said he, using language that might be strong, but perhaps not incorrect, "I was afraid of these serpents, the reviewers" (laughter and cheers.) Reviewers were certainly very valuable; but excellent as they might be, it was certain that they had the power of depressing merit. But the British Association put it out of the power of any one to depress genius, here real genius would always find some one to encourage its efforts and to bring forward its discoveries. There was a difficulty in the way of the Association, which these considerations might help to remove. The more eminent a man was, the greater object it was to have him at their meetings; but precisely in the same proportion was increased the value of his time—it became more difficult to extract him from his observatory or his laboratory, where he was pursuing his silent and unobtrusive researches, and bring him to the bustle of such a meeting as this. But this you could do if you proved to him that in the success of these meetings, the promotionof his favourite studies was at stake—that in fact they were valuable to the cause of Science. Mr. Harcourt concluded by stating, that the general committee, in strict adherence to their original plan, and to prevent all interference with other scientific bodies, had determined to limit the publication of their transactions to *reports upon the progress of science, and the account of researches undertaken by the direction of the Association.*

Mr. Taylor, the treasurer, then made a report of the state of the funds of the Society:—On the 30th of July last there was in the hands of the treasurer £509; in the funds 2361; and unsold copies of works about £560. In Dublin, the treasurer had received, from 1228 subscribers, £1750, together with an additional sum of £94 for books sold, making the total income £5214. The expenses and sums due by the Association were probably £1000, leaving a clear property of £4214. The receipts of the preceding year in Edinburgh were £1626, while in Dublin they amounted to £1750. It was also very gratifying to be able to state that grants for the advancement of science, of £1700, had been placed this year at the disposal of the committee.

Sir Thomas Brisbane then rose, and after a few prefatory observations, in which he expressed the happiness he experienced in having the honour of moving such a resolution, proposed the following.

That the thanks of the Britrsh Association for the Advancement of Science, be offered to his Excellency the Lord Lieutenant of Ireland, for the earnest and active part which His Excellency has taken in promoting the Interests of the Association at this meeting, and for the honour he has conferred on it by his presence.

Mr. Murchison in seconding the resolution said, I can alone have been selected to second this motion because I was once an aide-de-camp, and am, therefore, not out of place when I follow the gallant and enlightened general who has proposed it. As one of the original nucleus which brought together the first assembly of this association at York, I cannot have watched its successful progress without a conviction, that the steady gathering of such a clan was certain to overwhelm all opposition, and that its best motto has been "forward." Never, however, could any of us, however sanguine, have anticipated such a brilliant triumph as we have here achieved, through the aid of our Irish auxiliaries. Now I ask you all, if the acts of kindness by which his Excellency the Lord Lieutenant has sanctioned this meeting, whilst they do equal honor to his head and heart, are not admirably calculated to give to our body a character of *public* importance; and

if so, what effects must not such conduct produce in Ireland? Let any one who, like myself, has known this country in past times, now revisit it, and, amid the marked improvements which environ the metropolis, he wi.l soon perceive that there has been no change in the well-known national attribute of warmth of heart; so that, judging from the manner in which we have been received and cherished, may I not venture to predict, that the kind and courteous bearing of the Viceroy of Ireland towards the British Association, will be one of his best passports to secure the attachment of Irishmen.

The motion passed amid loud plaudits. A deputation was subsequently appointed, to convey the expression of the sentiments of the Association to the Lord Lieutenant, consisting of the Provost of Trinity College, General Sir Thomas Brisbane, Professor Sedgwick, Mr. W. V. Harcourt, Mr. Whewell, and Mr. Murchison.

Mr. Whewell moved a vote of thanks to the Provost and Senior Fellows of Trinity College. He said that it was with peculiar pleasure that he proposed this resolution—it was with, he might say, a brotherly feeling that he spoke of any institution bearing the name of Trinity College—it was the name of the college to which he himself belonged. He need not say how much they owed to the Provost and heads of the Irish university; their halls had been thrown open for their reception; in their chambers their members had found a home, and day after day had been spread for them the hospitable board (cheers); while the most distinguished members of that university had been toiling in their service, he might almost say day and night. Nor should he forget to mention, that the society of Trinity College had done special honour to the Association, by conferring on some of its most distinguished members the ancient and venerable titles of their degrees (loud cheers.) Mr. Whewell concluded by moving, "that the thanks of the Association be given to the Provost and Senior Fellows of Trinity College, Dublin, for the ample accommodation afforded by them to the Meeting."

Dr. Daubeny, in seconding the motion, expressed his sense of the kindness which the members of the Association had experienced, not merely from scientific institutions, from whom, in some sense, they had a right to expect it, but from commercial men, and from all classes of society.

The Provost returned thanks. He was much gratified by the terms in which the little attention the College had been able to show had been spoken of—not that they could claim any merit—but he was glad to be assured that their endeavours to fulfil what he considered a duty had been acceptable to the distinguished individuals whom they were but too happy to have as their guests (loud cheers.)

Professor Sedgwick rose to propose a vote of thanks to the Royal Dublin Society and the Royal Irish Academy. He had, perhaps, trespassed too long upon their patience the night before; he would now endeavour to be brief; indeed his physical powers to-day were reduced to the level of his intellectual (laughter.) He was exhausted by his exertions, and his accent was that which belonged to birds of evil omen (continued laughter.) [The learned Professor was so hoarse as to be at times inaudible, and to this circumstance we understood him to allude.] However, he was sure that the meeting would excuse him for this; it was the result of his exertions to please them, and they should regard him as a soldier returning home, covered with wounds received in their cause. Last night, when the committee had delegated him to address them, they had cautioned him against addressing them in the language of flattery (laughter.) To-day, however, he had got no such caution, and for this reason, that on the subject on which he had to speak, flattery was impossible. The merits of the Royal Dublin Society and the Royal Irish Academy put flattery out of his power. Were his lips touched with coals of fire, and his words of burning import, he could not speak of them as they deserved; it was upon the special invitation of these two Societies they had met in Dublin (cheers.) They acted as hosts, the Association was their guest. If voice and time sufficed him, he would say a great deal more. To the Royal Dublin Society they were indebted for the splendid entertainment in their beautiful gardens. From his heart he thanked the inhabitants of Dublin for their kindness. The Association was getting more prosperous every year; its success was perfectly astonishing. Some persons had hinted that its precocious glories foreboded premature decay; but looking to their fu-

ture prospects, he had no hesitation in saying that the pageant would become more and more glorious. (cheers.)

Professor GRAHAM seconded the motion. In Dublin, private individuals vied with public bodies in showing them attention. To the two societies mentioned in the resolution they were peculiarly indebted. If it had not been for the liberal accommodation they had afforded the Association, the arrangements of the meeting could not have been made; in fact, the meeting could not have taken place. He would not attempt to detain the meeting by expatiating on the delight of such an assembly of eminent men; for himself, he would say, that every sentient atom of his physical frame thrilled with delight as he grasped the hands of the men who bore the names that he long had venerated (loud cheers.) He must occupy them with one word more, as connected with societies of similar institution in Scotland. If there lingered in any mind the false conception, that in any part of his Majesty's dominions there existed a feeling hostile to the friendships and associations which this meeting of the Association had formed, he could assure the person who imagined this, that there was not a member of that Association who would not, wherever he might be, pray cordially, fervently and sincerely, for the peace, the happiness, and the prosperity of Ireland (great cheering.) For the societies of which he had spoken—the Royal Society, and the Antiquarian Society of Edinburgh—he would venture to promise, that in any way in which they could co-operate with the scientific bodies of Ireland, their cordial assistance might be confidently calculated on. (loud cheers.)

Baron FOSTER returned thanks on behalf of the Dublin Society. The Dublin Society was the oldest institution of the kind in Ireland, and it would have ill become it if it had not been the first to come forward on this proud occasion. Among the many benefits which the meeting of the Association would confer on Ireland, he hoped that it would stimulate the Dublin Society to increased exertions.

The next resolution, moved by Dr. TRAILL and seconded by Professor CLARKE, of Cambridge, was a vote of thanks to the Royal College of Surgeons, the Royal College of Physicians, the Zoological Society, and other public institutions of Dublin, which have shown hospitality to the members of the Association.

Dr. DALTON moved a vote of thanks to the Chamber of Commerce, the Dublin Library Society, and the Directors of the Dublin and Kingstown Railway, for the accommodation afforded to the members of the Association. Dr. Dalton was received, on his rising to move this resolution, with the most enthusiastic demonstrations of respect.

Colonel SYKES said that he was fortunate in being called on to second a motion which had been proposed by so distinguished an individual. The Chamber of Commerce and the Dublin Library Society had generously placed their literary stores at the unreserved disposal of the Association; but the directors of the railway had placed at their disposal their trains. Whatever literary bodies might do, it was hardly to be expected that commercial men would thus have given up their property to serve the interests of science. To the directors of the railway they were indebted for the delightful day they had passed at Salt-hill, where they had the advantage of the beautiful view of the splendid bay of Dublin. Three hundred members had been taken there in thirteen minutes; and after dining at Salt-hill they had returned to town within two hours from the time they left it. He must also mention, that they would on Tuesday have trains ready to convey the members to Sir John Tobin's steam-boat (cheers.) He could not conclude without expressing his thanks for the unbounded hospitality shown to the strangers in this noble city, and, personally, for the large share of it which he had himself received (cheers.)

Mr. BABBAGE then rose and observed, that he had been requested to propose a vote of thanks to Lieutenant-Colonel Colby, and the officers employed at the Ordnance Survey Office, for the liberality with which they had permitted their establishment to be opened for the inspection of the members of the Association, and the polite attention the members had there received. He took occasion to express his high sense of the importance of the survey, and his admiration of the manner in which it had been executed. He would not at all allude to the subject if it was merely as a compliment to those concerned in it; but he desired to express his opinion of the vast importance of the work. He also wished to say a few word

as to the expense, as advocates of rigid economy had objected to the statistical inquiries which had been combined with the geometrical survey. Now the fact was, that the procuring of this statistical information, which was of great importance, incurred little or no additional expense. He was himself a rigid economist, but still he fully approved of a liberal expenditure on a work like the survey. If done at all, it must be done expensively; but the expenses were very little increased by directing the collection of statistical information. It was necessary to employ intelligent men to ascertain the boundaries; it was necessary that these men should remain some days in districts; and in the evening such men would naturally employ those hours which could not be devoted to the survey, in making the very statistical inquiries to which he had alluded. It was not, then, these inquiries that entailed the expense. There was another advantage in the execution of this survey to which he could not help alluding; there must be a constant change in the persons employed in its completion; some persons constantly leaving the employment, and others succeeding in their place. He had ascertained that this took place to the extent of fifty persons each year, and thus the survey was actually a school, which each year sent forth fifty persons with a great deal of knowledge—trained in a most intellectual discipline—taught the practice as well as theory of science; and received fifty others, intelligent men, to undergo a similar process of improvement (cheers.) He then proceeded to announce to the meeting that the general committee had directed a vote of thanks in the following words, to be presented to his Excellency the Lord Lieutenant, for having furnished to the sections copies of the first part of the Ordnance Survey of the county of Londonderry.

To His Excellency, Constantine, Earl Mulgrave, Lord Lieutenant of Ireland, &c.

We, the Members of the British Association, beg to offer your Excellency our best thanks for the copies of the Ordnance Survey, of the parish of Templemore, transmitted by direction of your Excellency to the several Sections of our body, and our congratulations on the appearance of the first part of this great national undertaking. From the admirable manner in which this vast mass of statistical information has been given to the public, we look forward with confidence, that a work reflecting such high credit on that branch of the public service to which its execution was entrusted, and calculated to produce such important advantages to Ireland, will be carried on with as little delay as possible, and be completed in the same enlightened spirit.

The vote of thanks was seconded by Mr. Greenough, and carried unanimously.

Lieutenant-Colonel Colby, in returning thanks, on the part of himself and his coadjutors on the Survey, mentioned the favourable disposition with which the survey had been received in every part of the country. He also alluded to the very large number of assistants he had procured in Ireland, and the peculiar aptitude for numerical computations they appeared to possess. In return for the praise which had been bestowed on the work, he said, the officers employed on the survey would have been ungrateful to Ireland, for the manner in which the Ordnance Survey had been received, if they had not endeavoured to render it as perfect as possible for the benefit of the country.

Mr. Vernon Harcourt moved a vote of thanks to the President and Vice-Presidents of this meeting. Of their respected President, Mr. Sedgwick had so feelingly spoken, that he need not say any thing. Mr. Whewell was too well known to require eulogy from him. For their distinguished Vice-President, Lord Oxmantown, he was authorised to say, that press of particular business alone had prevented his being present.

Mr. Powell seconded the motion. It was unnecessary for him to add a single word to the brief recommendation of his friend who had moved this resolution. He would, however, take this opportunity of stating, on the part of a distinguished individual whom he was proud to call his friend—he meant the Archbishop of Dublin—he would now state on the part of his Grace, that it was with great regret his Grace had been obliged to absent himself on very important public business in London (hear, hear.) Nothing else could have prevented his Grace from being at this meeting, and manifesting that anxiety for the diffusion of useful knowledge which his Grace had at all times so eminently displayed (hear, hear.) This much he was authorised to state on the part of his Grace. He would trespass for a very short time, but he was anxious to say a few words. He congratulated the Association on the harmony and unanimity which pervaded this meeting; he meant not merely that they were all cordially united in

the great object of promoting science; this was implied in the very fact of their assembling, but also, that men of all ranks—of all parties—of all religions—had met, as it were, on neutral ground (cheers.) Among their members they found men from the highest rank to the humblest followers of science. The man of the world met the man of business as an associate; men of all shades of political opinion united, and men of all religious persuasions joined to promote the interests of science, the basis upon which, in his opinion, the evidence of all religion rests. This was a point which, perhaps, had not been sufficiently insisted on; without the presumption of the truth of natural religion there could be no evidence for revealed. He wished them to bear in mind the religious tendency of science. It had been made an accusation against science that it did not involve the principles of religion; it might as well be objected to the first proposition of Euclid that it did not involve the forty-seventh. There was still a subject—he knew it was a delicate one—upon which he wished to say a few words. Among their members had been some of the Romish Priesthood—he believed some of the Romish hierarchy. This fact was worthy of notice, because—and he meant nothing invidious in what he said—it had been supposed that their church was not favourable to the progress of knowledge. They had found gentlemen of that church not only taking a part in their proceedings, but enlightening them by their knowledge and research (loud cheers.)

The following votes of thanks were then passed:

To the Secretaries of Dublin, the Treasurer, and the other members of the Local Council.—Moved by Mr. Taylor, and seconded by Professor Phillips.

To the Committee of Reception.—Moved by Sir John Franklin, and seconded by Professor Moll.

To the Foreigners present at this meeting, for the honor they have conferred on it by their attendance.—Moved by Professor Hamilton, and seconded by Mr. Griffith.

To the General Secretary, Mr. Vernon Harcourt.—Moved by Dr. Robinson, and seconded by Mr. Lloyd.

To the General Treasurer, Mr. Taylor.—Moved by Mr. Baily, and seconded by Dr. Orpen.

To the Assistant Secretary, Professor Phillips.—Moved by Professor Hamilton, and seconded by Professor Lloyd.

DINNER AT THE UNIVERSITY.

The Provost and Senior Fellows of Trinity College gave a farewell banquet on Saturday to about three hundred members of the British Association, in the Examination Hall of the University. The library was set apart for the reception of the company: the Provost and Senior Fellows were in attendance to receive their guests. His Excellency the Lord Lieutenant honoured the entertainment by his presence, and arrived soon after six o'clock, accompanied by Lieutenant-Colonel Yorke, Private Secretary, Captain Drummond, and three aides-de-camps.

Shortly after his Excellency's arrival, he addressed Professor Hamilton, to whom it had been previously intimated that his Excellency was desirous of conferring on him the honour of knighthood. His Excellency said—

"Professor Hamilton,—This is an exercise of one of those prerogatives of Royalty, of which I am here the representative, most grateful to myself—most in unison, I feel assured, with the wishes of that gracious sovereign, on whose behalf I act—most in accordance, I am equally persuaded, with the unanimous opinion of that enlightened people, for whose benefit all power is entrusted. This act does not so much confer distinction, as place the royal, and therefore national stamp upon that distinction, which has already been acquired by personal qualifications and individual exertions. On all these grounds, it is with the highest pleasure I now announce to you my present intention—more particularly in connexion with this occasion, where you fill a high official situation in that Association, as members of which we are here now congregated,—those foreigners by birth, strangers to each other in social ties, who are nevertheless drawn together by the irresistible attraction of mutual enlightenment—it is from this brotherhood of knowledge, that, as Ireland's Viceroy, I step forward to claim you as her own, and to appropriate to the land of your birth your distinguished reputation; and this I do, Sir, because, apart from every other consideration, I recognise in the expansion of intellect and the development of science, the surest sources of the eternal triumph of truth."

The Professor having knelt down, the Lord Lieutenant took the sword, and placing it upon the Professor's shoulder said, "I, Ireland's Viceroy, bid you rise, Sir William Rowan Hamilton."

The scene was highly imposing, and made a deep impression on all present. His Excellency's manner in the delivery of his address was peculiarly graceful and appropriate. On rising, Sir William Hamilton was warmly congratulated by his Excellency, and by all his surrounding friends and College associates.

The Provost then, as President of the Association, presented to his Excellency the address which had been voted to him at the General Meeting that morning, on the subject of the copies of the first part of the Ordnance Survey, which had been struck off for the inspection of the members of the Association, by order of the Lord

Lieutenant. To this address his Excellency gave a verbal answer, expressing his sincere pleasure that the labours of the Survey had met with so much approbation from the members of the British Association, and assuring them that there would be no unnecessary delay in the prosecution of this great national work.

It may be here mentioned, in connexion with this part of the day's proceedings, that the University this morning conferred its highest distinction, the honorary degree of Doctor of Laws, on

Sir Thomas Brisbane,
Mr. Baily,
Mr. W. Smith,
Professor Moll, of Utrecht,
M. Agassiz, of Neufchatel.

At seven o'clock, dinner having been announced by the state bedel of the University, the company proceeded to the Examination-hall. The appearance of this splendid apartment was magnificent in the extreme—it was brilliantly illuminated with wax lights. At the top was a semi-circular table, elevated on a dais; this was appropriated to the Lord Lieutenant, and a few of the distinguished members of the Association. From this table there were four extending the entire length of the room. At the head and foot, and at the centre of each, the Senior and Junior Fellows took their seats, in order that the proper degree of attention should be paid to the guests, a duty which was performed with untiring courtesy. The tables were laid out magnificently with *tableaux* of multiform device, and *pieces montées* of the most elaborate workmanship; the massive antique plate of the University was all put into requisition. The dinner was sumptuous, and everything conspired to diffuse satisfaction and delight amongst the visitors.

His Excellency the Lord Lieutenant was seated at the right hand of the Provost, and the late President of the Association, Sir Thomas Brisbane, on the left. Among the other individuals at the same table were—Lord Adare, Lord Cloncurry, Lord Cole, Sir John Franklin, Sir John Ross, Professors Moll and Agassiz, Mr. Vernon Harcourt, Secretary of the Association, Mr. Taylor, the Treasurer, Mr. Thomas Moore, Dr. Dalton, Dr. Daubeny, Professor Sedgwick, Professor Rigaud, Mr. Whewell, Mr. Babbage, Mr. Baily, Mr. Murchison.

Among the guests at the other tables were—Lord Clonbrock, Lord Massy, Rt. Hon. F. Blackburne; Generals Browne, Sir J. Douglass, Sir H. Scott; Colonels Thackeray, W. Smith, D'Aguilar, Sykes, Story, Birch, Campbell, Burgoyne, Calder, Gwynne, Montgomery; Hon. F. Ponsonby, C. Harris, Hon. and Rev. E. Chichester; Sirs A. Bellingham, G. Mackenzie, A. Crichton, T. Luscombe, H. Meredith, F. Madden; Professors Alison, Phillips, Trail, Johnston, Jeffray, Wheatstone, Knight, Moseley, Graham, and Powell; Count Wedel Jarlsberg, Baron Wedel Jarlsberg, (Norway,) Baron Barclay de Tolly, (Russia,) M. de Tocqueville, M. de Montalimbert, M. de Verneuil, M. de Beaumont, (Paris,) M. Searle, (Vienna,) Dr. Peithman (Berlin,) Dr. Nachot, (Saxony,) Drs. Roget, Coulter, Lardner, Dr. Hahn, (Germany,) M. Strom, (Norway,) Col. Dick (New Orleans,) Mr. Ticknor, (Boston,) Rev. W. de Lancy, (Philadelphia,) Dr. Humphreys, (United States,) Dr. Martinez del Rio, (Mexico,) Dr. Yellowly, Captain James Ross, R. N. Rev. James William M'Gauley, Mr. Greenough, G. Rennie, Dr. Smith, Dr. Barry, Mr. Cooper, Captain Sabine, &c. &c.

A "grace" composed by Dr. Smith, and dedicated to the President and members of the British Association, was chaunted by the composer, aided by Messrs. Robinson, Jager, and Buggine. The beautifully solemn strain of melody which pervaded this composition, delighted every one present. It was sung most effectively.

After dinner the *Non Nobis Domine* was sung by Doctor Smith, the Messrs. Robinson, Jager, and Buggine, in admirable style.

The Provost rose and proposed the first toast—

"The King." enthusiastically drunk with three times three. Air, "God save the King," by Doctor Smith, in the chorus of which the entire company joined.

The next toast was—

"The Lord Lieutenant"—three times three.

His Excellency expressed his deep sense of the obligation for the high honour conferred upon him, and begged permission of the chairman to propose a toast. His Excellency's request having been complied with, he proceeded to exputiate upon the benefits of the British Association—indeed (said his Excellency) it is impossible to over-rate its advantages (applause.) Meetings such as this is, are what Ireland most wants (hear.) Thus would she be seen, studied, and understood—thus would a concentrated combination of intellect be brought to bear upon her condition, the good resulting from whence would be incalculable (hear, hear.) When he proposed the health of the Provost, and prosperity to that Association, which then saw Ireland for the first time, he might be allowed to express a hope that its visit would be often repeated (applause.)

"The Provost, and prosperity to the British Association"—three times three with all the honours.

The Provost briefly expressed his acknowledgments.

[The immense expanse of hall prevented any of the speakers from being heard fully or distinctly.]

Glee—"Hail! smiling morn" was here exquisitely sung by Dr. Smith Messrs. Robinson, Jager, and Buggine,

Rev. Dr. Robinson, who occupied the vice-chair, proposed—

"The English Universities," amid loud cheering.

Dr. Robinson went on to say, that the success which had crowned the efforts of the British Association was mainly owing to the fostering protection of Oxford and Cambridge. (Applause.) Who that had seen the handful of members that first met at York—who, he would ask, could have anticipated the increase which Oxford exhibited, or its further development at Cambridge? At Edinburgh, and at Dublin, a further impulse was given to the mass, which was gathering magnitude as it rolled along (hear, hear, and applause.) Through the range of the British universities the association had passed. Now its destiny was certain; who would dare to prophecy its downfall? (hear, hear.) Now was it at the full maturity of its vigour. (applause.) Within a year it was said, that this gigantic association would perish. Where is the prophecy but within the crazed imaginations from which it proceeded?—(cheers.) It was not in the power of circumstances to arrest its course (renewed applause.) Doctor Robinson proceeded to recapitulate the many advantages the scientific world derived from the universities, and spoke in high terms of the Oxford and Cambridge Professors present, as well as of those who were unavoidably absent, and concluded by giving—

"The English Universities, and may they long continue to diffuse the light of science all over the globe"—drank with great enthusiasm, and three times three, and all honours.

Doctor Daubeny returned thanks on the part of the University of Oxford, and said the feelings of Oxford were in no degree lessened towards the British Association.

Mr. Whewell, on the part of the Cambridge University, expressed his sense of the honour.—Improvement in human knowledge was going on—would go on—it was not possible to retard it (hear.) There was one point which strongly pressed upon him at that moment; it was now one hundred and thirty years since a great man in another Trinity College knelt down before his sovereign, and rose up Sir Isaac Newton (immense applause.)

Sir William Hamilton next presented himself, and with great feeling and eloquence, particularly in allusion to the honour so lately conferred upon him, proposed—

"The Scottish Universities,"—three times three, and great applause.

Professor Graham spoke in acknowledgment of the toast.

The Rev. Dr. Singer, F. T. C. D. proposed the healths of

"The Illustrious Foreign Associates."

The eloquent strain of the reverend gentleman's observations, and the deep religious feeling in which he concluded them, called forth the most enthusiastic expressions of approbation.

Professor Moll expressed his thanks in brief but energetic terms.

Mr. Whewell next proposed

"The University of Dublin"—drunk with three times three, and great applause.

The Provost returned his acknowledgments.

The Lord Lieutenant, on rising to depart, said he had been anticipated by Mr. Whewell in the toast which had been just drunk. After bowing to the distinguished persons at the table around him, his Excellency retired, accompanied by the Provost, Colonels Yorke, D'Aguilar, and his Excellency's aides-de-camp. Shortly after ten o'clock, the company retired, highly gratified at the scene they had witnessed.

EVENING MEETING AT THE ROTUNDA.

The last meeting at the Rotunda was quite as fully attended as the previous ones.

Dr. Barry gave an interesting narrative of an ascent of Mount Blanc, in the summer of 1834. The details have been already published by him in the *Edinburgh Philosophical Journal* for January, 1835. Dr. Barry mentioned that he did not experience any difficulty of breathing in the higher regions of the mountain, although previous travellers have complained of suffering very much from that cause.—Only 20 persons have been known to gain the summit of Mount Blanc, and of those, 12 were Englishmen.

Professor Babbage made some remarks upon a whirlpool found in the Mediterranean, bordering upon Cephalonia, through which the sea has poured for forty years. He had applied to Lord Nugent, the governor of Corfu, to know whether he was acquainted with the fact, and that nobleman gave him a statement upon the subject, which he would endeavour to report—although, perhaps, not with sufficient accuracy, as he had not the document with him. The following is an extract of the statements referred to.—

Cephalonia, May 31, 1835.—"Mr. Stevens who is building the Mill, has written me out an answer to your questions, and I cannot do better than give you his own words. For the last three months he has been on the spot all day long, and, is therefore, very competent to judge of it. I see it most days myself as it is only a mile from our quarters.

"The hole mentioned by Captain Martin, was, when first discovered, a small fissure about four inches square, between two rocks on the edge of the sea. An excavation has since been made, and sea water is now conveyed through a channel running from north to south, 20 yards in length, and three feet wide, into a pit nearly 100 square yards in extent, and about four feet below

the level of the sea. At the bottom of this Pit there is a perpetual deposit of fresh spring water, which rises and falls with the tide, in the ratio of about 2 inches to every foot of ebb and flow of the sea.

"On opening the sluice through which the sea can be admitted at pleasure, a stream of 150 square inches rushes into the Pit, with a velocity of twenty feet a second, down a channel in the form of a segment of one-ninth of a circle, of 18 feet in diameter.

"A constant discharge of a quantity of water from the sea, of the above magnitude, has the effect of raising the water in the Pit to within 2 feet of the top of the arched channel, but it will rise no higher unless a greater body is admitted, and will fall proportionably with a lesser discharge. In the direction the water takes it appears to pass through the fissures, between the loose blocks of limestone which lie at the bottom of the Pit, and under the sides. Some of the fissures seem to be immensely deep, but as they are always full of water, and the loose blocks are singularly heaped on each other, the depth cannot be ascertained. Attempts have been made to discover the direction the water takes, by sinking shafts at different distances from the Pit, but without success;—the only light that has been thrown on the subject, is, that fresh water is found at the bottom of the shafts on a level with that of the Pit, and that it rises and falls, and partakes of the saltness in an exact proportion with the latter, when the sluice is opened or closed, proving that there is a communication between them. It is a singular fact that when the sluice gate is shut down, after a very considerable discharge of sea water has been allowed to fall into the Pit, the water that lodges in the Pit falls a few inches lower than it was previous to the discharge, until by means of the small springs of fresh water which are distinctly to be seen oozing up in various parts of the Pit, it again reaches the level it had before. This circumstance accounts for the water gradually recovering its freshness, after the sea has been excluded for a few hours.

"There are several other apertures which admit the sea water, in the neighbourhood of the one described, but they have not yet been explored; two of them are below the sea within a foot or two of the shore. The existence of these apertures, has been long known to the boatmen and fishermen who frequent this part of the coast, but this did not attract general notice, until two of them fell under my observation for the first time, after a residence of nearly twenty years in the Island, about a year and a half ago; the locality where they are found is composed of clay and limestone near the surface, and loose blocks of limestone below."

"Mr. Stevens is hard at work at this moment building a Mill, with a water wheel, of 18 feet diameter and 3 feet wide. In a fortnight he expects it will be at work, and he entertains no doubt that it will work, but whether it will cover an expenditure of 4 or 500 pounds is another thing."

Mr. Babbage said that the waters which disappeared might go into vast hidden receptacles, not yet filled up—or they might be disposed of by the volcanic agency known to exist in that neighbourhood.

Professor Wheatstone next gave to the meeting an interesting account of the various contrivances which have been made to imitate the human voice, from the speaking machines of the ancients, to those of Kempelen and the German mechanists, and the instrument for the production of the vowel sounds, contrived by Mr. Willis, of Cambridge. The Professor explained the general principles of machines of this nature, and the manner in which the various combinations of vowels, diphthongs, consonants, &c. were effected. The machine which gave the vowel sounds only, was provided with a large pair of bellows, which discharged a stream of air through a tube with a reed inserted in it; this tube, by certain arrangements at its end, gave the modifications of each as *Aw, Ae, A, E, O, Ow, &c.* A scale, divided into inches and tenths, was constructed for sounding any of those vowels at pleasure.

The instrument for pronouncing consonants was furnished with a series of valves, which, acting upon the beginning or end of the note (which in this case the vowel may be considered) gives it that articulation of which P, T, K, B, D, G, will serve for examples as acting on the beginning of the vowel, and are called expulsives," while *F, V, Sh, S, Th, Dh, &c.* from acting upon the note in another way, may be called "continuous." In this manner letters were connected, and words formed, and from words short sentences were constructed with considerable accuracy.

At the close of the lectures the company retired to an adjoining room, where, for a short time, they enjoyed themselves in social intercourse, and partook of refreshments.

In addition to the various public *dejeuners*, dinners, &c. mentioned in the foregoing Report, there were several other entertainments given by private individuals, which should not, perhaps, be altogether passed over without notice. Among others, a very elegant breakfast given in the Rotunda, to a large party of the Association, by Dr. Evory Kennedy; a dinner at the Observatory, Dunsink, by Sir William Rowan Hamilton; and a splendid *dejeuner* given on Monday, the 17th of August, to upwards of one hundred members of the Association, by Mrs. Putland, at her beautiful marine villa, near Bray, in the county of Wicklow.

A very pleasant scientific excursion was made to the Island of Lambay, on the morning of Monday, by a select party of the Association, consisting chiefly of

Geologists and Botanists, who proceeded from the North wall, on board the Adelaide steamer. In sailing along the east side of Howth, they were much interested in observing the curious curved contortions which occur among the immense masses of quartz rock, which compose the bulk of that bold promontory. After spending about three hours on the island, the respective parties of Geologists and Botanists returned on board, the former loaded with beautiful specimens of porphyry, green-stone, &c. also with some specimens of a limestone formation, apparently originating from petrified masses of ulva cactuca, and other species of algæ. Among the plants picked up by the Botanists were limbarda tricuspis, crithmum maritimum, three varieties of erica cineria, and other interesting plants and lichens. The whole party consisting of twenty-five, breakfasted and dined on board, where ample provision had been made for the purpose by Mr. Thomas Hutton, to whom they were indebted for the trip. The following were the gentlemen composing the party:—

Rev. Joseph Crampton, Birmingham, Mr. Henry Hutton, Mr. C. S. Parker, of Liverpool, Dr. Corry, of Birmingham, Dr. Robert Graves, Dr. William Stokes, Dr. Hart, Dr. Aquilla Smith, Dr. Trail, of Edinburgh, Dr. Scouler, Dr. Hugh Fergusson, Dr. Neill, of Edinburgh, Mr. Eddington, Mr. Robert Ball. Rev. Sidney Smith, F. T. C. D., Mr. T. Jameson Torrie, of Edinburgh, Mr. John Curtis, of London, Rev. William Bruce, of Belfast, Mr. David Don, of London, Mr. Westmacott, of Edinburgh, Mr. Forrest, of London, Mr. Niven, Mr. Mackay, Mr. Thomas Hutton.

Thus terminated a week of Meetings as interesting and important, as any ever held in the metropolis of Ireland—a week during which party and politics appeared to be forgotten—a week which will long be remembered by those who had the happiness of witnessing the kind and generous feeling which prevailed, and of listening to the remarks and observations of the numerous learned and scientific men, thus convened together. That the Meeting held in Dublin was as splendid as any of the Association Meetings which have yet taken place, is admitted on all hands; and we are persuaded, that a very slight review of the foregoing Report, must convince the most sceptical, that while those Members of the Association who *visited* Ireland, were entertained with the hospitality it is natural for Irishmen to show to strangers, the real objects of the Association were not neglected. We do hope, indeed, that measures will be taken to keep up the excitement awakened with regard to scientific pursuits, as nothing would render a greater service to the country. In our abounding population we have a sufficiency of mere animal labour, but to enable us to compete with England or Scotland, we must have that animal labour trained by mental discipline—we want science—we want our mechanics not to be mere machines—and, we sincerely trust, that the suggestions thrown out by Mr. Reid in the Meeting on Thursday, will be taken up in the various great towns of Ireland, by those whose situation in life may enable them to carry his recommendations most efficiently into practice; in this way the beneficial influence of the efforts of the British Association will circulate from one class to another, and finally extend itself even to the very lowest grade in the community.

Having thus detailed the various particulars connected with the Meetings of the Association, we feel that it will not be an inappropriate *finale* to the proceedings, to mention, that in the course of the week following that in which the Meetings were held, a large party of the Members, chiefly those engaged in Geological pursuits, proceeded on a visit to Lord Cole, at his noble residence of Florencecourt, while another, principally such as were interested in astronomical observations, accompanied E. J. Cooper, Esq. M. P. for Sligo, to Markree Castle, where they had an opportunity of inspecting the very superior astronomical instruments belonging to that distinguished and scientific individual; one of which, his Achromatic Telescope, of which we give an engraving in the appendix, is the finest in the world; the object glass, which is 13.3 inches in diameter, being the largest ever made. Indeed, it is a matter calculated to afford gratification to Irishmen, that a private gentleman residing in a remote district of this country, should have, in a complete and well-appointed observatory, the most efficient telescope in the universe. During the time the party remained at Markree, they had an opportunity of discovering the position of Halley's Comet. On the 27th ult. Mr. Cooper addressed the following letter on the subject to the Editor of the Evening Mail:—

Markree, August 27, 1835.

SIR—I have just read, in your paper of last night, a notice on Halley's Comet, taken from the London *Courier*, stating that Sir James South and the Rev. Thomas Hussey had discovered it on Sunday morning last. This day's post has brought me a letter from the latter gentleman, containing a statement similar to that communicated to the *Courier*. The weather having been unfavourable here, I did not discover it until about one o'clock yesterday morning, when I immediately showed it to Sir William Hamilton, who is staying with me at present. I first saw it in the finder of my great telescope, which has an object-glass, of four inches nine-tenths aperture. It was certainly faint in this telescope, but by no means so much so as other objects which I have seen through it. In the great telescope of thirteen inches three-tenths aperture, it was beautifully shown, and its nucleus perfectly distinguishable. It would not, however, bear illuminated wires, so that I could not obtain micrometrical measures. By read-

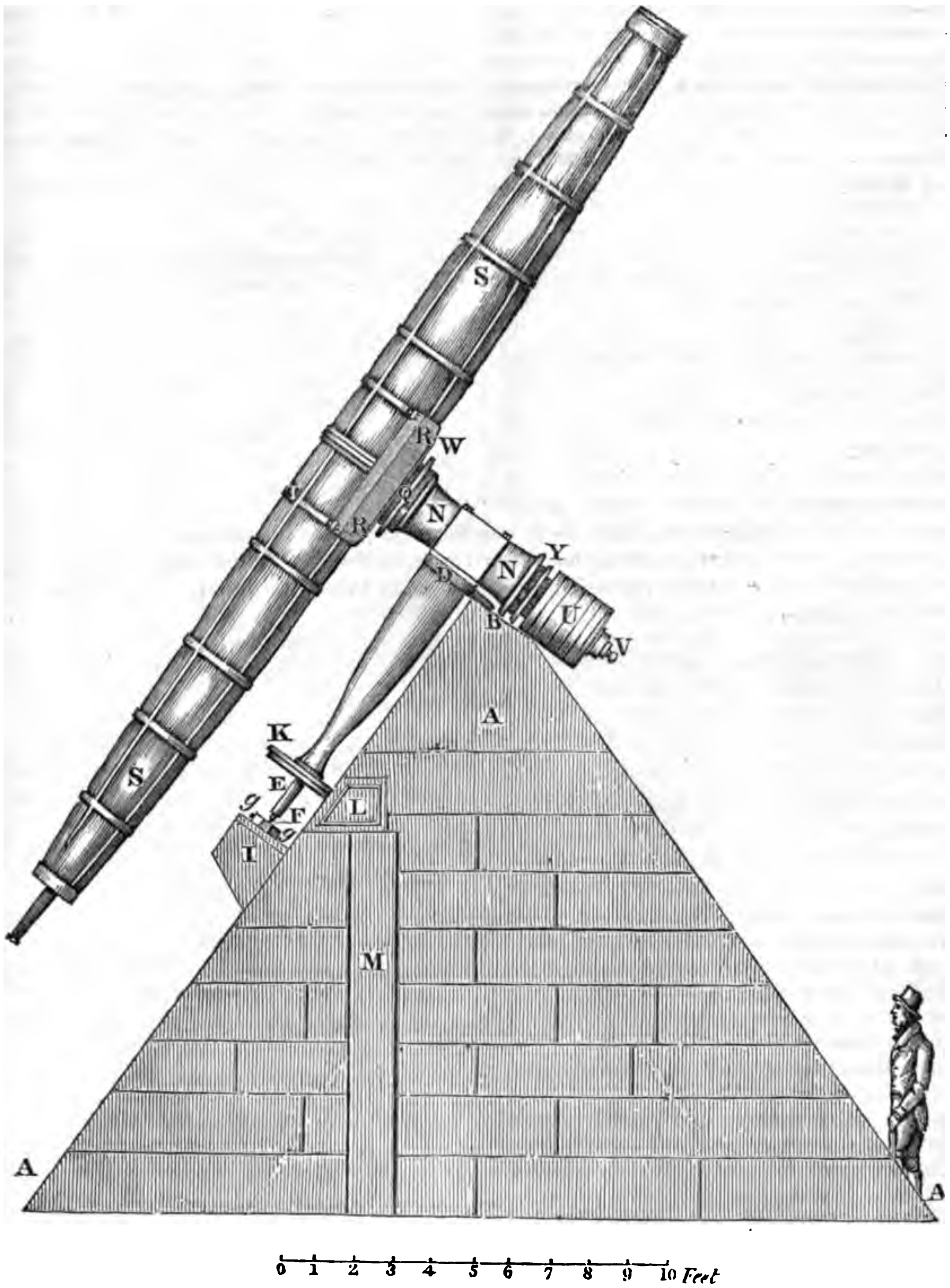
ing off the circles of the equatorial, checked by neighbouring stars, we found its right ascension to be—5^h, 45′. 19″, and its declination—24°. nearly. Some rough observations of ingress and egress into an unilluminated field, made by Sir William Hamilton, appeared to him to indicate a motion such as the comet ought to have; but the shortness of the time during which those observations could be made, left us desirous of further confirmation, such as a subsequent night would give. I, therefore, merely announced our observations by letter, yesterday, to Dr. Robinson, at Armagh; Mr. Henderson, at Edinburgh, and Mr. Baily, in London. There is a mistake, (a misprint, probably,) in the account you have given of it. It is in the east, not the west. I do not conceive that a telescope, with an object-glass of less than from three and a-half to four inches aperture will show it at present, and such a one very imperfectly. The best indication of its place that I can suggest to a person possessing a telescope of this size, is, that it sweeps into the field with two large rich clusters of stars, which are near each other: one of them being 35 Messier, and the other vi. 17, of Sir W. Herschel; the comet being several minutes to westward of them—Your very humble servant,

EDWARD J. COOPER.

ERRATA.

Page 27, 2d column, line 20 from bottom, *for* numerous, *read* luminous.
34, 1st column, line 11 from bottom, *for* their equations *read* these.
34, 2d column, line 13 from bottom, *for* Cochet *read* Cauchy.

APPENDIX.



EQUATORIAL MOUNTING OF MR. COOPER'S GREAT ACHROMATIC TELESCOPE.

DESCRIPTION OF THE EQUATORIAL MOUNTING OF MR. COOPER'S GREAT ACHROMATIC TELESCOPE.

(Referred to in page 81.)

The sketch is an elevation on a scale of ¼ inch to a foot, of the Telescope, &c. as seen from the east side, and represents the instrument as pointed to the Polar Star, at six hours after transit.

The Pier, A, A, A, is composed of large blocks of black marble, well jointed, and in some places cramped together, four feet thick at base, and decreasing to three feet and a half at top; the north and south sides are sloped to the latitude of the Observatory, viz. 54° 10′, and have steps, (not seen in the figure,) and also landing places cut in them for convenience of ascending and reading the circles.

Two feet of the north side at B is sloped off, so as to form a right angle with the south side; into this part a strong cast iron frame is fixed, carrying two cast iron rollers, twelve inches diameter, with steel pivots, one inch and a half diameter, turning in very hard bell-metal bearings; part of one of these rollers is seen at C, they support the Polar Axis at its upper bearing, touching it in points, making an angle of 90° with its centre. D, E is the polar axis, of cast iron, turning between the friction rollers at D, at which place it is fifteen inches and a quarter diameter, and its lower part ending in a hardened steel pivot, turning in a block of very hard bell-metal at F; this block is moveable in the cast iron block, G, by means of four screws, *g*, and serves to adjust the polar axis; the box is screwed on the planed surface of a strong cast iron plate, H, which is firmly attached to the stone, I, projecting out of the Meridian side of the pier. K, the hour-circle of cast iron, with a strong circle of brass, properly secured to it, having its edge ratched into 720 teeth, in which the endless screw, connected with the clock, works, and graduated on the under side. L, a metal box going from side to side of the pier in the clock-work. M, a channel in pier for the clock-weight. N, N is a strong hollow piece of cast iron, square in centre for sixteen inches, and at each end cylindrical, with strong flanges; it is attached to the polar axis by four bolts, *n*, and carries friction rollers, 7 inches diameter; working on steel pivots, one one-fourth diameter; two of these rollers are seen at O, on them turns the declination axis, a small part of which is seen at P and Q: they support the axis at points which form an angle of 120 degrees with the centre of the axis, and therefore always include the centre of gravity of the latter between them. The declination axis of cast iron, twelve inches diameter, has, on the end next the telescope, a square flange, to which the cradle, R, is attached by four bolts; it is prevented sliding off the rollers, (or in the direction of its own length,) with very little friction, by means of a roller, five inches and a half diameter, having a long spindle fixed to it, and turning in bearings placed in the polar axis; this roller moves in a groove cut in the declination axis; the latter will on being inclined either way by the turning of the polar axis, cause one of the sides of the groove to bear against the roller, which, by partaking of any motion given to the declination axis, allows of the latter turning freely on its rollers without shifting laterally; the groove being about the hundredth part of an inch wider than the diameter of the roller, prevents the roller touching both sides of the groove at once. To the cradle R, of cast iron, is attached the telescope tube, SS, by two jointed wrought iron straps. T, the tube, is of rolled iron, twenty-four inches diameter in centre, sixteen inches at each end, of a panelled construction, weight 8 cwt. U is the counterpoise in six parts, of cast iron; the interior of each part presents an annular ring divided into six parts by partitions, which are filled with lead, except a space of 1-6th of two of those parts, which, being left vacant, affords a simple means of bringing the centre of gravity of the declination axis, &c. into its centre of revolution. At V is a cylindrical sliding weight, which, by being drawn in or out, adjusts the instrument for any difference in eye pieces, &c. W is a ratched circle, fixed to the transverse part of the polar axis; an endless screw attached to the cradle works in it, and turns the telescope in declination. Y is the declination circle, fixed on the declination axis, and led off by microscopes, attached to the upper part of the polar axis.

The entire, being polished, has been rust-bronzed, to resist the effects of damp. A force of three pounds applied to the eye-tube of the telescope, is sufficient to move the instrument in any direction. The weights are as follow:

	cwt.	qr.	lbs.
The Equatorial stand, including every part but telescope and counterpoise...	25	3	21
Tube, Object-glass, Eye-tube, &c.......	9	0	14
Counterpoise..................................	12	1	19
	47	1	26

EXPLANATION OF DR. SCOULER'S MAP.

OBJECTS OF GEOLOGICAL INTEREST IN THE VICINITY OF DUBLIN.

NORTH OF DUBLIN.

PORTRANE.—This peninsula consists chiefly of limestone, which is remarkably contorted, the strata resting on their edges, and curved in a very complicated manner.

LAMBAY ISLAND.—This island consists of conglomerate rocks of different kinds, chiefly of argillaceous schist, including fragments of other rocks. There is also a stratum of sandstone conglomerate at the northern extremity of the island. In some places the schist is greatly contorted. Green-stone and porphyry are extremely abundant, alternating with and passing into greywacke.

MALAHIDE.—The country in this vicinity consists entirely of mountain limestone. The quarries of Malahide, Feltram, and St. Doolagh, afford numerous organic remains.

The following is a list of organic remains collected from different situations:

Articulata.—Calymene sp. common everywhere.	Terebratula lineata.
Mollusca.	——— resupinata
Bellerophon hiulcus.	——— acuminata.
——— costatus.	——— reniformis.
Ellipsolites ovatus.	Spirifer cuspidatus.
Nautilus carinferus.	——— attenuatus.
——— biangulatus.	——— trigonalis.
Ammonites sphæricus.	——— glaber.
Orthocera striata.	——— obtusus.
——— fusiformis.	——— striatus.
Ampexus coralloides.	Cardium hibernicum.
Cirrus acutus.	Sanguinolaria gibbosa.
Euomphalus pentangularis.	*Zoophytes*
Turitella sp.	Turbinolia Fungites.
Buccinum acutum.	Caryophyllea affinis.
Isocardia oblonga.	Lithotrotion floriforme.
Productus comoides.	——— striatum.
——— sulcatus.	Tubipora catenata.

KILLESTER, near Clontarf.—Impressions of organized bodies occur in the upper beds of limestone; these impressions are however so obscure, that nothing more than their vegetable nature can be inferred.

CLONTARF.—A vein of lead occurs in the limestone, which was worked a few years ago, but is now abandoned.

HOWTH.—The peninsula of Howth and the adjacent island of Ireland's eye, consist chiefly of quartz rock. The phenomena of contortions are here exhibited in great variety and distinctness. The quartz is interstratified with schistose rocks of a great variety of colours, rendering by their contrast the curvatures of the beds very apparent.

The following minerals occur in this locality:

Iron pyrites	Oxide of manganese.
Copper pyrites.	Earthy black cobalt ore.
Galena.	

Beds of MAGNESIAN LIMESTONE occur at the north eastern extremity of Howth, at Sutton. These beds occur near the junction of the blue limestone with the primary strata; are interstratified with it, and include loose angular fragments thereof.

Near the town of Howth there is an extensive mass of stratified alluvium, attaining the thickness of about 100 feet, and containing fragments of marine shells of the same species as those which still exist in the adjoining sea.

IMMEDIATE VICINITY OF DUBLIN.

LUCAN.—The contortions of the limestone (calp) are displayed with great distinctness at the quarries near Lucan.

DONNYBROOK.—In the quarries at Donnybrook there are numerous strata of calp, passing into the ordinary limestone, and containing organic remains.

MILLTOWN.—Between Milltown bridge and Classon bridge there is a portion of magnesian limestone, which is included in the ordinary limestone. Granite is visible at a short distance from this place, but its contact with the stratified rocks has not been detected

RATHGAR, CRUMLIN, and ROUNDTOWN.—The operations of quarrying have disclosed an extensive series of strata of calp limestone. The calp alternates with strata, and numerous such alternations may be counted. In all these quarries the limestone is highly inclined, and exhibits other indications of disturbance.

SOUTH OF DUBLIN.

BLACK-ROCK.—On the Coast near the railway there are a series of rocks which are best observed at low water. The granite may be seen within a few feet of the limestone, but the actual contact of the two rocks cannot be observed. The limestone is hard and crystaline, and appears as if it had been shivered into angular fragments, which have been subsequently united.

KINGSTOWN.—The country around Kingstown and the Island of Dalkey consists entirely of granite. Almost every block of granite is traversed by concretionary veins of the same substance, differing from the general mass in the texture, colour, and relative proportions of the usual ingredients

The following minerals have been found in the granite

Spodumene.	Garnet.	
Killinite.	Tourmaline.	
Beryl.	Apatite.	These extremely rare.
Fluor.	Rutile.	
Copper pyrites,	Sphene.	
Iron pyrites.	Orthite.	
Galena.		

KILLINEY.—On the sea coast, immediately below the obelisk, the junction of the granite with the mica schist occurs. The edges of the schistose strata repose on a basis of granite. The schist is much contorted, and sometimes so convoluted as to form concentric crusts. At the line of junction the schist abounds in crystals of Andalusite grouped in a stelliform manner.

Numerous veins issue from the granite, and intersect the micaceous schist; some of the veins run parallel to the lamination of the schist, others run parallel to the direction of its stratification, and consequently one set of veins intersects the other.

In one instance a heave has taken place, and the two portions of the granite vein are displaced.

These veins frequently contain fragments of micacious schist.

ROCHESTOWN HILL.—The line of junction of the schist with the granite may be traced for a quarter of a mile, and is remarkable for its clearness and precision.

In this locality the spheroidal structure of the granite may be observed.

SCALP.—A deep ravine has cut across the granite and schist, so that their contact may be easily observed. The shistose rocks recline against the granite, and are much contorted. Crystals of Staurotide occur near the Scalp.

BALLYCORUS.—At a very short distance from the Scalp a vein of lead ore occurs near the junction of the schist and granite.*

Galena, sulphate of barytes and carbonate of lead are found here.

SHANKHILL.—This hill is composed of quartz rock, and its stratification is not very apparent. On the west side of the hill, where it approaches the granite, the quartz is changed into hornstone.

BRAY HEAD consists of quartz rock and argillaceous schist in frequent alternation. The strata in many places rest on their edges, and are turned and contorted in every direction, exhibiting phenomena analogous to those observed at Howth.

To the south of Bray there is an extensive mass of alluvium containing broken shells.

GREATER and LESSER SUGAR LOAF.—These hills consist of quartz rock without any argillacious schist, and their stratification is obscure.

RATHFARNHAM.—The junction of the granite and micacious schist may be observed near the commencement of the Military Road.

GLENISMAULE.—The junction of the granite and schist may be traced to a considerable distance on the southern side of the valley.

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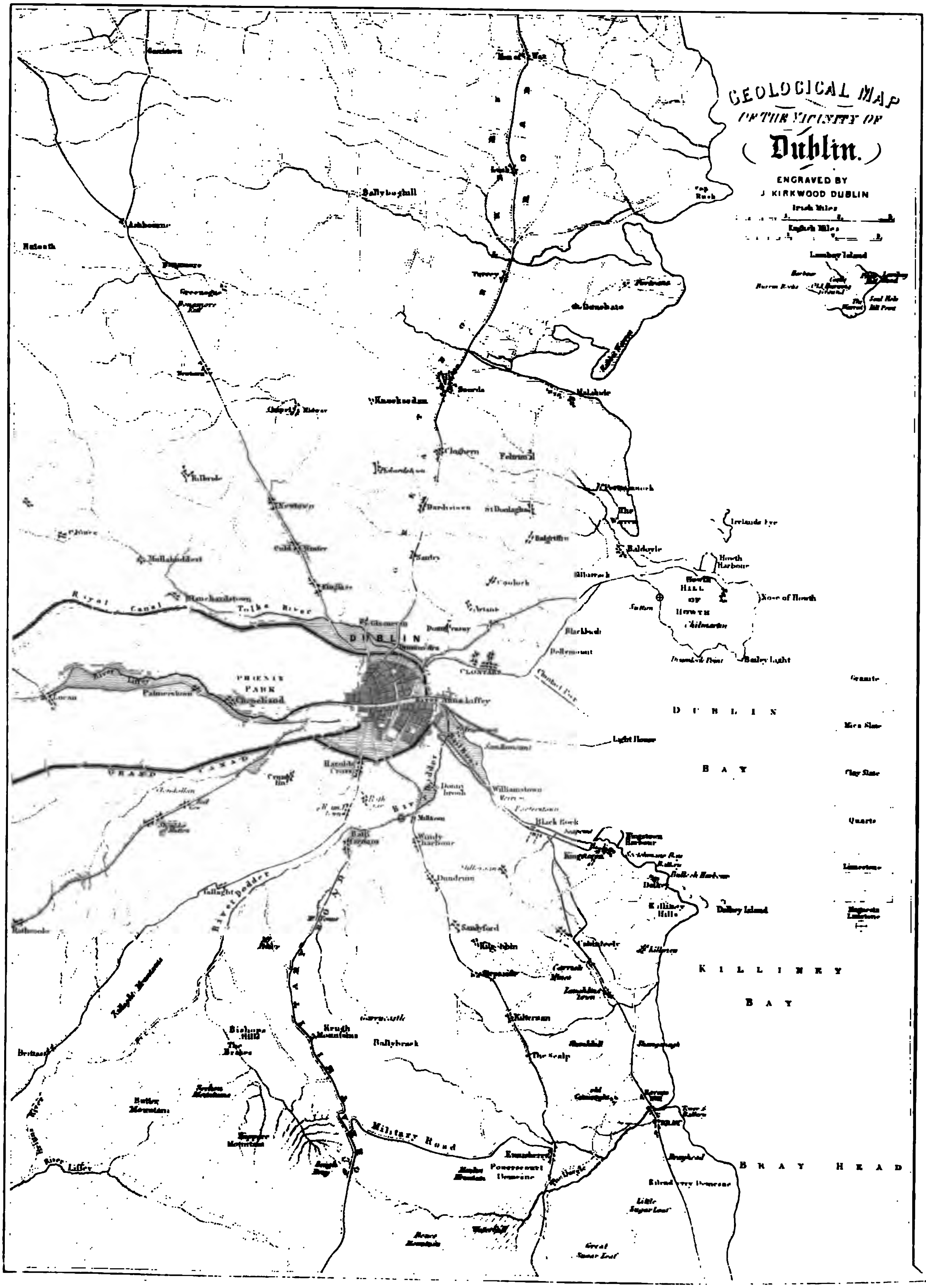
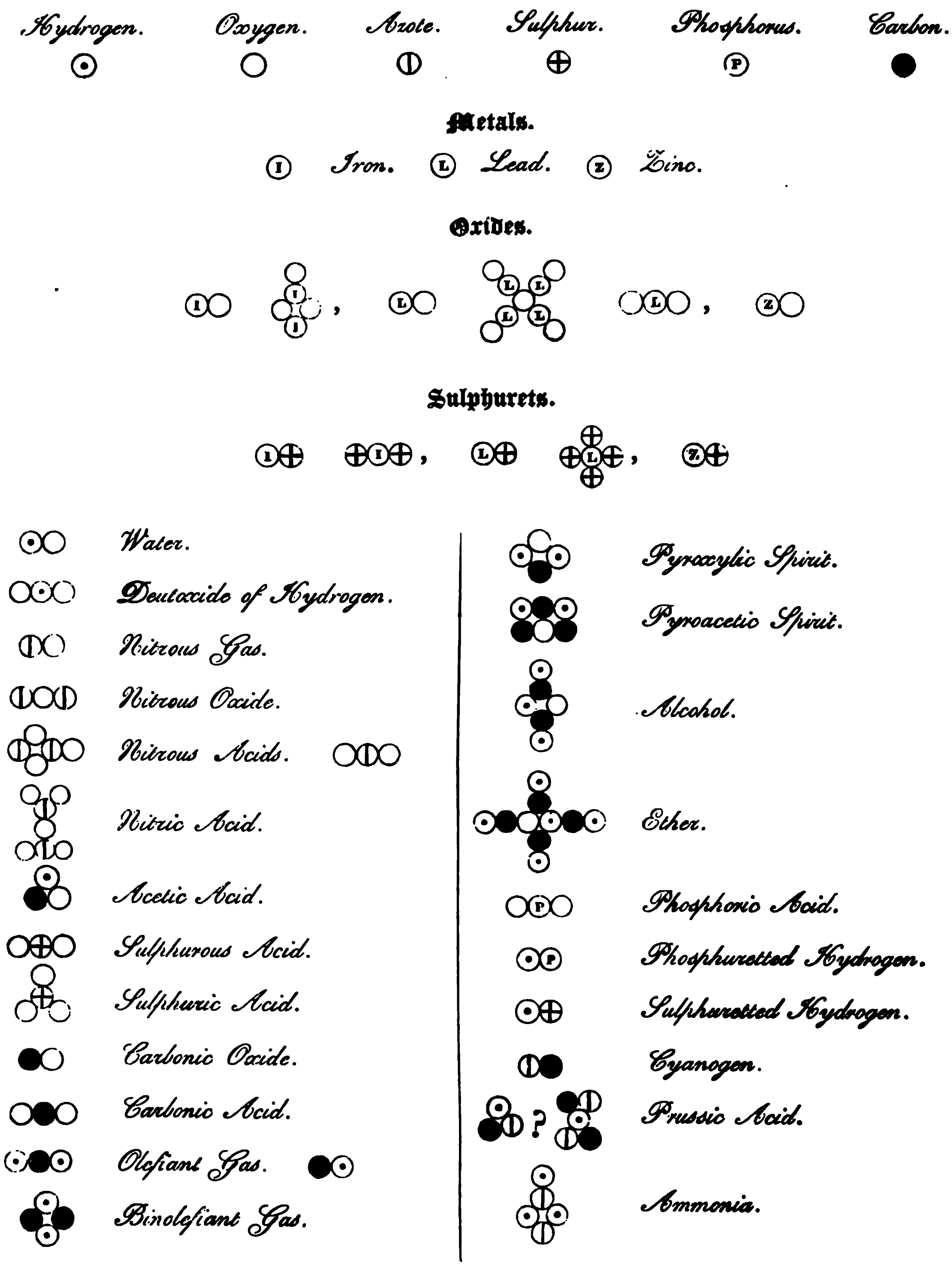
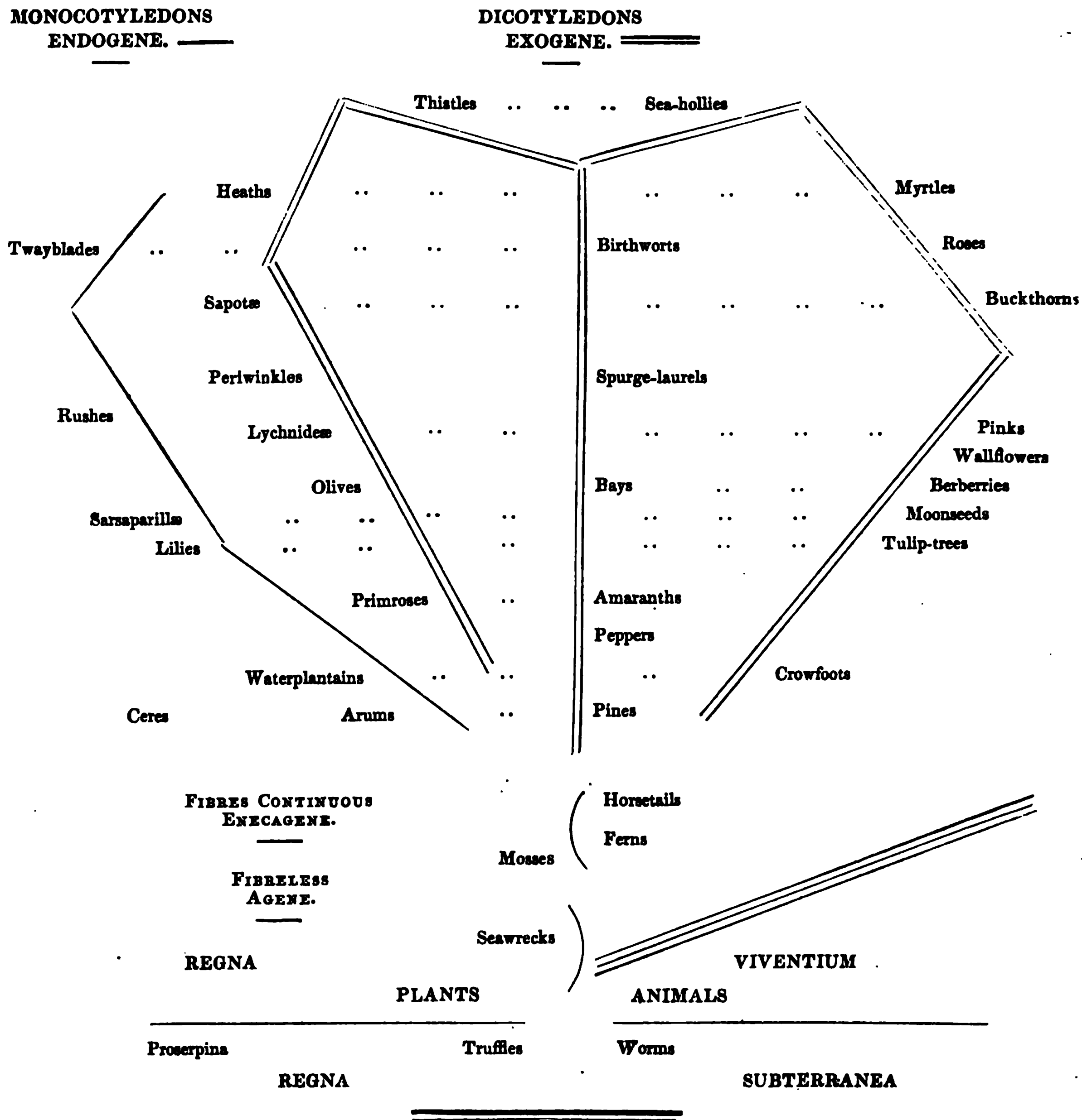
* This vein has been worked by different mining companies, and is at present in the possession of the Mining Company of Ireland, who have works for smelting, and for rolling and drawing pipes. Shot is also manufactured here.


GEOLOGICAL MAP
OF THE VICINITY OF
Dublin.
ENGRAVED BY
J. KIRKWOOD DUBLIN
Irish Miles
English Miles
Lambay Island
Ballyboghill
Ashbourne
Ratoath
Turvey
Donabate
Swords
Malahide
Knocksedan
Cloghran
Feltrim
Portmarnock
St Doulaghs
Balgriffin
Baldoyle
Ireland's Eye
Howth Harbour
HILL OF HOWTH
Nose of Howth
Sutton
Baily Light
Santry
Coolock
Artane
Finglas
Blanchardstown
Mulhuddart
Royal Canal
Tolka River
DUBLIN
CLONTARF
PHOENIX PARK
Palmerstown
Chapelizod
Lucan
River Liffey
Light House
DUBLIN BAY
GRAND CANAL
Harolds Cross
Donnybrook
Williamstown
Milltown
Black Rock
Kingstown Harbour
Kingstown
Dalkey
Dalkey Island
Killiney Hills
Dundrum
Sandyford
Kilgobbin
Cabinteely
Carrickmines
Loughlinstown
Tallaght
River Dodder
Rathcoole
Kilternan
Ballybrack
The Scalp
Shankhill
Brittas
Butter Mountain
Kippure Mountain
Military Road
Enniskerry
Powerscourt Demesne
Bray
BRAY HEAD
KILLINEY BAY
Little Sugar Loaf
Great Sugar Loaf
River Liffey
Granite
Mica Slate
Clay Slate
Quartz
Limestone
Magnesian Limestone

DR. DALTON'S PROPOSED ATOMIC SYMBOLS.



DR. ALLMAN'S ARRANGEMENT OF PLANTS.



The animal, vegetable, and mineral kingdoms of nature form not a linear series; but from the mineral kingdom the other two depart, each by its lowest order.

The worm and the oak cannot be confounded; neither can the vegetable kingdom naturally form a linear series.

De Candolle calls his linear series, consequently, artificial. It was considered whether the higher groups of vegetables might not exhibit similar departures from the lower. Passing up, in the cellular plants, appeared the mosses almost fibred, then the ferns completely so; yet their fibres neither endogene, nor exogene; but continued, enecagene, marking the point of departure in distinct lines of the monocotyledons and dicotyledons.

For illustration of the continuation of this process, dissolving Jussien's fifteenth class, and uniting his tenth and eleventh, passing up the apetalous dicotyledons, then from the birthworts may depart in distinct lines, the monopetalous and the polypetalous; making these look backward, (to venture no further at present,) a four-lined warp is obtained; it being desired to make (if it might be done) the cross lines of a piece, illustrating, it may be, what modern Botanists call, analogy.

The plan has been partly attempted in a recent botanical course.

LIST OF MEMBERS

OF THE

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE,

ENROLLED IN DUBLIN, AUGUST, 1835.

MEMBERS OF GENERAL COMMITTEE MARKED THUS (*)

Atkins, William, 12, Royal Canal Terrace
Auchinleck, Wm. R.C.S. 39, Dominick-street
Adair, John, 11, Mountjoy-square, South
Adams, Dr. Wm. O'Brien, M.R.C.S. Cavendish Row
Adair, Henry, 11, Mountjoy-square, South
Adams, Neason, M.D. 72, Stephen's-green
*Adams, Robert, 11, Great Denmark-street
Armstrong, Andrew, 17, Trinity College
Aher, David, Castlecomer
Abbott, Joseph, 16, Gloucester-street
Alcock, E. V. 3, Hume-street
Alcock, Benjamin, M.D. Frederick-street
Alexander, Edward, 35, College-green
Atkinson, George, 26. Lower Bridge-street
Abell, Joshua, 27, Eustace-street
*Allman, William M.D. Professor of Botany, T.C.D 4, Marino Crescent
Armstrong, Rev. George, 3, Upper Leeson-st.
*Apjohn, James, M.D. Professor of Chemistry, Royal College of Surgeons, Dublin, 22, Lower Baggot-street, M.R.I.A.
Alison, William P. M.D. F.R.S.E. Professor of the Institutes of Medicine in the University of Edinburgh, 17, Upper Fitzwilliam-street
Anster, John, LL.D. 12, North Frederick-street
Adare, Lord, M.R.I.A. Limerick
Addams, Robert, London
Austin, Rev. Gilbert, Merrion-square, North
Aston, Lieutenant Henry, Bombay Army
Astle, Wm. Henry, M B. Edenderry
Andrews, Thomas, M.D. Belfast
Allen, William, Balbriggan
Ash, Rev. Edward J. M.A. Tutor of Christ's College, Cambridge

Barker, J. 24, North Cumberland-street
Bruce, Haliday, 37, Dame-street
Barrett, James, Junior, 103, Baggot-street
Beasley, H. F. 5, Fitzwilliam-square, West
Beatty, Thomas E. M.D. Molesworth-street
Brady, Daniel, F. 58, Old Dominick street
Brereton, David, M.D 12, York-street
Bagot, John, 1, Rathmines-road
Bell, James W. 1, Gardiner-street
Borrowes, Robert, 7, Merrion-square, North
Brady, Thomas, M.D. 9, Great Charles-street
Ball, John, 85, Stephen's-green, South
Bourne, Frederick, Terenure
Bourne, W. H. Mount Clarence, Kingstown
Bowen, Charles, Junior, 51, Stephen's-green, E.
Benn, Rev. William, B D. 8, Harrington-street
Bushe, Rev. Wm 8, Mountjoy-square, North
Boswell, John K. 182, Great Brunswick-street
Blacker, Colonel, 8, Merrion-square, North
Borough, Edw. M.R.I.A. 5, Merrion-square, W.
Baker, George, M D. 22, Amien's-street
Barnes, Joseph, 100, Marlborough-street
*Barry, Martin, M.D. Edinburgh
Burgoyne, Colonel, Office of Public Works
Betty, William, 32, Rutland-square
Bagot, Andrew, 1, Rathmines-road
Bagot, Charles, 1. Rathmines-road
Beasley, Thomas, Fitzwilliam-square
Barrett, James, 103, Baggot-street
Barrett, James, Junior, 103, Baggot-street
Butler, Charles, M.D 53, Lower Sackville-street
Blood, David R. 92, Lower Gardiner-street
Bevan, William, 3, Leeson-street
Barnes, Thomas, 8, Upper Pembroke-street
Boswell, Wm. M.D. 115, Stephen's-green, West
Bowen, Charles Jones, 51, Stephen's-green
Bagot, Andrew, Junior, 61, Fleet-street
Barker, William. A.B. 22, Baggot-street
Blood, Bindon, Esq. F.R.S.E., M.R.I.A., Cranaher, Co, Clare

*Barker, Francis, M.D. 22, Baggot-street
Ball, Robert, Mountjoy-square, North
Botfield, Thomas. F.R. and G.S. Hopton Court, Bewdley
Booth, James, 24, Trinity College
Bland, Rev. R. W. (Belfast) 23, Pembroke-street
Bruce, Rev. William, (Belfast) Glasnevin Lodge
Bland, Loftus, 23, Upper Pembroke-street
Bessonet, James, 28, Leeson-street
Brenan, John E. 3, Dawson-street
Blackley, Travers, 139, Leeson-street
Brady, Maziere, M R.I.A. 58, Blessington-street
Butt, Isaac, A.B. 12, Trinity College
Burke, John L. 17, Rutland-square
Byrne, Thomas, M.D. 24, College
Beasley, Thomas John, Fitzwilliam-square, W.
Barlow, H. C. London
Bevan, Philip, 1, Hatch-street
*Brisbane, Sir Thomas Macdougal, M. A. of Cambridge, K.C.B. F.R.S. L. and E Corresponding Member of the Institute of France, Mukerston, Kelso
*Babington, Charles, C. St. John's College, Cambridge
Burne, James, Upper Baggot-street
Bourne, Andrew, 27, Lower Fitzwilliam-street
Bond, W.M. Armagh
Brady, John J. 9, Great Charles-street
Bellingham, O'Bryen, 63, Eccles-street
Boyle, Alexander, 35, College-green
Bell, David, 60, Blessington-street
Barlow, Francis. Lower Gardiner-street
Barker, Richard, 123, Great Britain-street
*Babbage, Charles, M.A. F.R.S L. and E. Lucasian, Professor of Mathematics in the University of Cambridge, 1, Dorset-st. London
Benson, Charles M.B. 34, York-street
*Beale, Samuel, Birmingham
*Bryce, James, M. A. Belfast
Bourne, Richard, Lynnbury, Westmeath Dawson-street
Beatty, William C. M.D. 28, Molesworth-street
Barlow, Major, 14th Regt. Richmond Barracks
Baker, Rev. Nicholas. 2, Hamilton-row
Brenan, John, Sixclerk's Office, Inn's-quay
Bryan, R. Butler, Eccles-street
Bergin, Thomas F., 5, Westland-row
Butler, William, Archer, Cahir
Blackburne, Right Hon. Francis, Leinster-st.
Busby, John. Monkstown Avenue
Bradley, John, M.D. 39, Lower Gloucester-street
Birch, Lieut.-Colonel, 23, Pembroke-street
Baily, Francis, V. P. R. S. Tavistock-place, London
Bradshaw, Robert Scott, Belfast
Boase, C. W. Dundee
Barlow, John, Clontarf
Bradshaw, Rev. John, Lisburn
Boyton, Rev. Charles, Letterkenny
Barlow, Peter, 5, Great George's-street, North
Brown, Wade, Roebuck
*Broughton, S. F.R. and G. S. (12, Great Marlborough-street, London
Birch, William John. A.M. London
Blacker, Maxwell, 9, Merrion-square, North
Bordes, Lieut. Ordnance Survey Office, Phœnix Park
*Blackburn. Charles, A.B. London
Barnes, John, Horndean, Hants
Bingham. William, M.A. Oxford
Ball, Nicholas, 85, Stephen's-green
Brown, James, M D. Glasgow
Bayne, Wm. Joseph, M.D. Bury, St. Edmunds
Bayly, Henry, Templestown, Suffolk
Bennett, Lieutenant, R.E. Kells
Baily, John, Nenagh

Baily, Richard H. Nenagh
Boileau, Simeon, Fitzwilliam-square
Burke, Charles, Galway
Barber, R. H. Edinburgh
Bowles, Lieutenent-G. Ordnance Survey Office
Blakeney, Sir Edward. Commander of the Forces
Barnwall, Hon. Thomas, Bilton's Hotel
Barton, John, 44, Mary-street
Barclay, Thomas, Castlebar
Brandreth, J. M. Preston
Blunt, Henry, Shrewsbury
Burton, Decimus, F.R.S. London
Benson, Robert, Jun. Liverpool
Brandreth, Henry, London
Bolster, Rev. John A. Cork
Bell, John, Royal Barracks
Brewer, Lieutenant Charles, Leith Fort
Booker, Rev. John, Wexford
Bishop, William Chatterley, Cambridge
Bruce, Robert, Bristol
Bunbury, Sir J R. Bart, M R I A County Tyrone
Bald, William, F.R.S.E. Board of Public Works
Burke. C. Granby, M.R.I.A. Cambridge
Bellingham, Sir Allan, Castle Bellingham
Barton, Augustine, 6, Fitzwilliam-square, South
Bodkin, Martin, Tuam
Bell. E. G. Mayo
Bardin, Charles, D D. Cookstown
Boyd, John C. Belfast
Buchanan, M.S. M.D. Glasgow
Burroughs, Edward, Worcestershire
Berwick, Walter, 9, Lower Fitzwilliam-street
Bacon, Robert, Londonderry
Bewley. Samuel, Rockville, County of Dublin
Botfield, Beriah, Norton Hall
Brodigan, Thomas, Drogheda
Baldwin, Rev. John, Cambridge
Burrowes, Commissioner, M R I A. Leeson-street
Bagot, Thomas M. County of Galway
Blake, Isidore A. Galway
Burt, John, G. M. Edinburgh
Burke, Francis, 5, Upper Rutland-street
Brown, Brabazon, 115, Baggot-street
Beauchamp, Coulson Henry, M.D. 23, French st.

Clibborne, Edward, Cullen's-wood
Campbell, William Wilson, M.R.I.A. Lying-in-Hospital
*Carmichael, And. M.R.I A. 24, Rutland-square
Cusack, James William, M.R.I.A. 3, Kildare-st
Corrigan, John, M.D. 4, Merrion-square, West
*Coulter, Thomas, M.D. M.R.I.A. 28, College
Courtney, Rev. J. K. Finglass
Connor, George, 5, Dawson-street
Colles, Abraham, M.D. 24, Stephen's-green, N.
Collins, John Vickers, 10, Denzille-street
Crawford, Andrew, 133, Leeson-street
Curry, William, Jun. 9, Upper Sackville-street
Clarke, Sir Arthur, 44, N. Great George's-st.
*Clerke, Major Shadwell, K.H. F.R.S. London
Campbell, Lieut.-Colonel, Pigeon House Fort
Crawford, John, 111, Grafton-street
Clarke, Thomas, 123, Lower Baggot-street
Churchill, Fleetwood, M.D. 104, Stephen's-green
Caldwell, Nathaniel, 9, Bachelor's-walk
Caldwell, Robert, 9, Bachelor's-walk
Colles, William, Steevens'-hospital
Codd, Francis, 52, Townsend-street
Cooke, Howard, M D. 71, Blessington-street
Corballis, John R. LL.D. M R.I.A. 15, Baggot-st
Corrie, John, F.R.S. 54, Harcourt-street
*Carmichael, Richard, M.D. M.R.I.A. 24, Rutland-square
Cook, James Richard, A.M. 71, Blessington-st.
Creighton, George W. 7, Upper Pembroke-st.
Culley, Robert, Bank of Ireland

LIST OF MEMBERS.

Curry, John, Sir John's-quay
Costello, Philip, 44, Old Dominick-street
Corballis, James, 11, Fitzwilliam-square, East
Clonbrock, Lord, Clonbrock, Galway
*Collins, Robert, M.D. 2, Merrion-square, North
Cooper, Rev Peter, 79, Marlborough-street
Cooper, J. S. M.R.I.A. Upper Merrion-street
Cash, Geo. M.R.I.A. 34, Rutland-square, West
Carmichael, Hugh, 18, Hume-street
Crosthwait, Leland, 63, Fleet-street
Clarke, Edward, Merrion, and Shelbourne Hotel
Chambers, James, Gardiner's-row
Courtney, Henry, 27, Upper Mount-street
Curran, W. H. 3, Holles-street
Cane, Richard, 60, Dawson-street
*Connell, Arthur, F.R.S.E. Edinburgh
Cooper, Joseph, B.A. London
Colles, Maurice, 20, York-street
Colby, Colonel, F.R.S. Tower, London
Campbell, Rev. James, James's-gate
Connor, Shewbridge, M D. 15, Eccles-street
Curtis, Patrick, Roebuck
Conway, F. W. M.R.I.A. 11, Trinity-street
Carter, Sampson, Kilkenny
Clements, Henry, Galway
*Critchton, Sir Alexander, Kent
*Carlisle. Hugh, Bushfield-avenue
Cross, Robert, M D. Wisbeach
Chaigneau, Peter, Upper Fitzwilliam-street
*Curtis, John, F L.S. Upper Charlotte-street, Fitzroy-square, London
Claridge, James, M.S.A. London
Calder, Lieut.-Colonel, 76, Upper Stephen-st.
Crampton, John, M.D. 39, Kildare-street
*Corrie, John Read, M.D. F.G S. Birmingham
Crompton, Rev. Joseph, Birmingham
Carlisle, Rev. James, 30, Upper Merrion-street
Cowan, T. Commander R.N. Edinburgh
Chichester, Rev. Edward. Kilmore
Cloncurry, Lord, Maritimo
Corbet, William, 23, Lower Baggot-street
Chittick, James, Enniskillen
Corr, Maurice, 20, Talbot-street
*Cunningham, Allan, 17, Lower Dorset-street
Colquhoun, Capt. United Service Club, Foster-place
Croker, Charles P. M.D. M R.I.A. Merrion-sq.
Clendinning, Alexander, Westport
Clendinning, John, M.D. London
Cole, Lord, Florence-court
Caulfield, William, Beaumaris
*Christy, William, London
Combe, George, Edinburgh
Cunningham, R J.H. Edinburgh
Corballis, Jas Joseph, Ratoath
Clarke, Edward S. Palmerstown
Clarke, Courtney, K. Ringsend
Clancy, John, 3, Fitzwilliam-square, South
Chichester, William, 12, Trinity College
Connor, H. Roebuck-house
Cotton, Archdeacon, Thurles
Clark, B. F.L.S. Corresponding Member of the French Institute, London
Chapman, Rev. John, F.T C.D. Trinity College
Connell, Archibald, Edinburgh
*Clarke, Rev. William, M.D. F.G.S. Professor of Anatomy, Cambridge
Cosby, Major W. Belvedere-place
Carleton, William, Edward Terrace
Curry, William, K.C. 37, Summer-hill
Connor, Roderick, Four Courts
Crampton, Hon Judge, 1, Merrion-street
Crampton, Philip, Surgeon-General, Merrion-square
Collins, Stephen, Merrion-square
Cole, Edward
Coote, Captain Adolphus, Cooksboro'
Cloyne, Bishop of, M.R.I.A
Clayton, General Browne, Adlington-hall, Lancashire
Cozins, Inspector-General, London
Curtis, John W. Alton, Hants
Carson, James, M.B. Liverpool
Chiverton, Benjamin, London
Chawner, Dr. Darwin, Nottinghamshire
Craig, William, M.D Glasgow
Campbell, Rev. James, D D Gresham's Hotel
Cuthbertson, Rev. Alex. A.M. Berwickshire, Scotland
Claxton, William, Bristol
Clinton, P. Dominick-street
Cahill, Michael, Carlow
Cubitt, William, M.R.I.A. London
Cubitt, Joseph, London
Carson, James, M.D. Liverpool
Cardwell, James, Lancashire
Carley, John, Belfast
Courtney, Richard, 117, Baggot-street
Cooper, E. J. M.R.I.A. Morrison's Hotel
Cotter, John, Cork
Cunningham, William, Castlepollard
Childers, Captain Wm. Walbanke, Enniskerry

Duncan, James, M.D. Finglass
D'Olier, Isaac, LL.D. M.R.I.A. 18, Baggot-st.
Davies, John, M.D. 31, Lennox-street
*Davy, Edmund, Profe sor of Chemistry, Royal Dublin Society, M R.I.A.
*Douglass, J. C. M.D. 6, Dominick-street
Dillon, Edward, 39, York-street
Downes, George, A.M, 37, Aughrim-street
Dowell, Rev. S. Seafield
Darley, Rev. John, A.M. Dungannon
Dowdall, Hamilton, Belmont
Day, Robert, 8, Lower Fitzwilliam-street
D'Arcy, Thomas, M.D. 76, Aungier-street
*Drummond, W. H. D.D. M.R.I.A. 28, Lower Gardiner-street
Digby, Rev. W. Kingstown
Denham, John, M.D. 50, William-street
Dwney, Thomas, Junior, 4, Westland-row
D'Olier, Isaac, M.R.I.A. Bank of Ireland
Duffey, John, 5, Upper Fitzwilliam-street
Doyne, Philip, 10, Merrion-square, East
Davis, Charles, M.D. Anne-street
Dawson, George, R. E.
Dobbin, L. M.P. Armagh
Dobbin, Leonard, Jun. 23, Gardiner's-place
*Dalton, John, D.C.L. Member of the Institute of France, Manchester
Dickinson, Rev. Charles, D.D. M.R.I.A. 21, Baggot-street
Dwyer, Henry Law, A.M. M.B. 1, Upper Camden-street
Drennan, William, 37, North Cumberland-st.
*Don, David. F.L.S. Soho-square, London
Disney, Rev. B. 42, Rutland-square
Dick, William, Edinburgh
D'Aguilar, Colonel, Royal Hospital
Darbishire, Samuel, Manchester
Daly, Colonel, London
Dawson, Lieutenant Ordnance Survey Office, Phœnix-park
Duncan, James F. 37, Marlborough-street
Dickinson, John, 67, Stephen's-green
Desormeaux, E.I.C.S. Madras
Duckett, William, Tuthill's Hotel
Darley, William Frederick, 20, French-street
Disney, Rev. James, 4, Wettland-row
Dames, W. H. Francis, Greenhill
Duncan, Dr. W. H. Liverpool
*Denham, Captain, H M. R.N. Liverpool
Deck, Isaiah, Cambridge
Daubeny, Chas. Professor of Chemistry, Oxford
Davis, Francis, Waterford
Drummond, Dr. Richmond Barracks
Douglass, General Sir James, Limerick
Davenport, E. D. Cheshire
Deane, William, 72, Dame-street
Darby, Rev. Joseph, Spadacini's Hotel
Dennis, William, M D. King's County
Duckett, Joseph F. Carlow
Douglas, Francis Brown, Edinburgh
Darley, Frederick, 25, Lower Fitzwilliam-street
Duke, Jemmett, County of Sligo
Dawson, Charles, Ordnance Survey, Llangollan, N. Wales
Dawson, Robert, Ordnance Survey, Llangollan, N. Wales
Daly, Philip, 12, South Frederick-street
Dickinson, Robert, 26, Summer-hill
Daly, James, Dunsandle

Evans, George, M.P.
Elrington, Rev. C. D.D. M.R.I.A.
Eames, Rev. William, 40, Bride-street
Evanson, R. T. M.D. M R.I.A. 36, Dawson-st.
Edington, William, M.R.I.A. 18, Leinster-street
Eustace, John, M.D. 21, Upper Gloucester-st.
Elliot, Commissary-General, 6, L. Pembroke-st.
Emerson, J. S. 49, William-street
Ettrick, William, Sunderland, Durham
Everard, Richard, 9, Grenville-street
Ellis, Richard, 12, Fitzwilliam-street
Evans, John, London
Eyre, John, 29, College
Ellis, George, M.B. 5, South Frederick-street
Ennis, John, Harcourt-street
Edington, Thomas, Jun. 19, Westmorland-st.

Foote, Simon, Essex-bridge
Ferrier, Alexander, William-street
Ferrier, Alexander James, William-street
Fleming, Christopher, M.D. 9, Molesworth-st.
Fox, Rev. S. W. 96, Stephen's-green
Ferrall, J. M. 38, Rutland-square
Field, Henry, M.D. M.R.C.S. Blackrock
Franks, Robert, 152, Leeson-street
Farran, William, Dundrum
Ferrier, Alexander, Jun. Knockmaroon
Fitzgerald, Rev. John, Loughlinstown-house
Fitzpatrick, Thomas, M.D. 12, Park-street
Fowler, Robert, 19, Merrion-square, South
Ferguson, Montgomery, M.D. 8, South Anne-st
Foot, Lundy Edward, 14, Upper Fitzwilliam-st.
*Ferguson, Dr. J. C. 16, Frederick-street, North
Ferguson, William, 38, A.B. Mary-street
Fannin, Robert, Jun. 10, Harrington-street
Finlay, John, LL D. 31, North Cumberland-st.
Ferguson, Hugh, M.D. M.R I.A. 62, Sackville-st
Fitzpatrick, Matthew, 12, Peter-street
*Fox, Robert Were, Falmouth
Franklin, Captain Sir John, R.N. 1, Merrion-sq.
Flood, P. T. 28, Lower Monnt-street
Fostor, Francis, Madeira
French, Charles, Club-house, Kildare-street
Farran, Joseph, 44, York-street
Ferrall, Thomas, 3, Merrion-square, East
Flynn, Rev. Thomas, 3, Kildare-place
Flood, Val. M.D 19, M R I.A. Blessington-st.
Fletcher, W. LL.D. Merrion square
Fraser, James, 17, Lowar-street
Finlay, James, Newcastle-upon-Tyne
Fox, R. B. Falmouth
Fox, Charles, Falmouth
*Fox, George T. Durham
*Fenwick, John, Newcastle-upon-Tyne
Foster, E. Jun. Cambridge
Fitzgerald, George, London
Foster, William, 13, Merrion-square, East
Ferrier, James, William-street
Forster, Robert, 18, Summer-hill
Forster, William, 18, Summer-hill
Fairnbairn, William, Manchester
Furniss, B. Edinburgh and Sheffield
Finnucane, Andrew, Tommey's Hotel
Foster, Hon. Baron, 3, Merrion-square, East
French, Arthur, 9, Mountjoy-square, West
Furlong, John William, 146, Leeson-street
Furlong, Rev. Thomas, 146, Leeson-street
Foster, John V. Merrion-square
Fannin, Robert
Frazer, James
Ford, Thomas, 12, Mountjoy-square, South
Forrest, Richard, Heathfield-terrace, Farnham-green
Flood, Charles James, Lower Mount-street
Ferguson, Joseph, M.D. Mullingar
Field, Joshua, London
Filgate, W. H. Castlebellingham

Gregory, Very Rev. James, 17, Upper Fitzwilliam-street, Dean of Kildare
Geoghegan, Rev. Edward, 8, Hume-street
Gregory, John, 17, Gloucester-place, North
*Graves, Robt. J. M.D. M.R.I.A. 9, Harcourt-st
Graves, Rev. Richard H. D.D. Mitchelstown
Graham, Captain Richard, Ballymahon
Green, George, M D. 14, Harcourt-street
Griffith, Arthur H. 8, South Frederick-street
Grubb, Thomas, Parnell-place
Griffith, Walter H. 13, Clare-street
Goodall, Ebenezer, 19, Molesworth-street
Geoghegan, Thomas, M.D. 52, York-street
Greenough, G. B. F.R.S. and L.S. P.G.S. Regent's Park, London
Gason, Joseph W. M.D. Stevens'-hospital
Graham, Thomas, F.R.S.E. Glasgow
Griffith, W. Vicars, 9, Mount-pleasant, North
Godby, Augustus, General Post Office
Grooby, Rev. Jas. F.R.A.S. 26, Westmorland-st.
Green, John A. L L. B. 107, Lower Gardiner-st.
Gresson, William, 19, Dominick-street
Gayer, Arthur E. 11, Upper Mount-street
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Gibbon, Geo. Brunswick-street and Sandymount
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Greene, F. W. Kilranelagh
Graves, Charles, 22, Trinity College
Gill, John Edgcumbe, 17, Denzille-street
*Griffith, Richard, F.R.S.E. M.R.I.A. 2, Fitzwilliam-place
*Greg, W. R. Manchester
Gotch, Thomas Henry, Kettering, Northamptonshire
Gotch, Frederick William, 19, Charlemont-st.
Grace, Percy, Captain, R N. London
Graydon, Lieut-Col R. E. Morrison's Hotel
*Graham, Professor Robert, Edinburgh
*Granville, Dr. London
Gordon, Alexander T. Edinburgh
Gore, Francis, Stephen's-green
Greene, John, Clonliffe-parade
Griffin, Daniel, Limerick.
Greham, Rev. John, LL.D. Waterford
Gwynne, Col. A G., F.R.S.E. Cardiganshire
Gale, Peter, Queen's County
Gale, James, 104, Gardiner-street
Goold, Francis, 20, Merrion-square, North
Grut, Nicholas, 7, College-green
Guinness, Benjamin Lee, James's-gate
Guinness, Arthur Lee, James's-gate
Guinness, Rev. William, Beaumont
Guinness, Robert R. Stillorgan
Gillman, John, 160, Capel-street
Graydon, William
Gray, Roderick, Enniskillen
Gilby, William Robinson, A.M., F.R.A.S. Beverly, Yorkshire
Grant, George, Liverpool
Gregory, Rt. Hon William, 3, Merrion-square
Gore, Philip Y. Dublin Castle
Gilby, Lieut. B.A. 81st Regt. Royal Barracks
Gwatkin, Frederick, London
Goldsmid, Francis, F.R.S. London
Gordon, Osborne, Oxford
Graham, George, County of Wicklow
Gresham, Thomas Michael, Sackville-street
Grimshaw, Robert, Belfast
Green, Richard W. 49, Stephen's-green, East
Gason, John, M.D. Enniskerry
George, Rev. C. H., A.B. 30, Lr. Dorset-st.
Greer, John
Guinness, Arthur, Beaumont
Graham, Captain R.

Hutton, Henry, 6, Mountjoy-square, South
*Hutton, Robt. F.G.S. M.R.I.A. 16, Summer-hill
Hargrave, William M.B., T.C.D., 37, York-st.
Huddart, Rev. T. P 14, Mountjoy-square, S.
Hutton, Rev. Joseph, A.M., Fairfield, Glasnevin

Hamilton, Charles William, 37, Dominick-st.
Hone, Nathaniel, 53, Harcourt-street
Hunt, Percival, M.D., 14, Merrion-street
Humfrey, Henry, 14, Park-street
Hodgkinson, F. LL.D. S.F.T.C.D.
Hartstonge, Major R. Weld, 15, Molesworth-st.
Hone, Joseph, 47, Harcourt-street
Hutton, Edward, M.D. M.R.I.A. 33, Summer-hill
Harris, William Lindsay, M.R.C.S. 46, William street
•Hart, John, M.D. 93, Lower Mount-street
Henry, William, 69, Abbey-street
Hutton, Thomas, 114, Summer-hill
Hughes, John, 10, Denzille-street
•Harrison, Robert, M.D. 1, Hume-street
Houston, John, M.D. 31, York-street
Hume, William, 3, Belvedere-place
Hamilton, Arthur, M.R.I.A. 10, South Cumberland-street
Hardiman, James, M.R.I.A. Galway
Hetherington, George, M.B. Stevens'-hospital
Howell, George, 33, Molesworth-street
Hutton, Daniel, 6, Lower Dominick-street
Haig, Charles, 3, Warrington-place
Hudson, Rev. Edward, 39, Up. Fitzwilliam-st.
Hamilton, John, 13, Nassau-street
•Hamilton, Sir William R., M.R.I.A., B.A., F.R.S. Astronomer Royal of Ireland, Observatory, Dublin
Hutton, Henry, 18, Gardiner's-place
Hayes, Charles, 40, Lower Mount-street
Halpin, Rev. N. J. Seville-place
Hart, Wm. Sterne, 17, Fitzwilliam-square, W.
Hooke, Bridges John, 17, Harcourt-street
Holmes, Rev. William, 5, Belvedere-place
Hodder, Thomas, U. S. Club, Foster-place
Hudson, Dr. Alfred, 13, Nassau-street
Halpin, George, 10, Middle Mountjoy-street
Hacket, Michael, Booklawn, Palmerstown
Hartshorn, William, 86, South Gt. George's-st.
Hyndman, John E. Belvedere-place
Hanna, Samuel, A.M., M.B. 3, Leinster-street
Henry, David, 92, Stephen's-green, South
•Haliday, Alexander Henry, A.M. Belfast
•Harty, William, Gardiner-street
Hamilton, Rev. John, 79, Marlborough-street
Haire, Robert, 19, Summer-hill
Hart, Andrew S., F.T.C.D., 13, Trinity College
Hudson, Henry, M.D. 24, Stephen's-green, N.
Horsfall, C. H. Liverpool
Hardman, Edward, 4, Upper Mount-street
Hoare, Lieutenant Thomas, Cullenswood
•Hodgkinson, E. Manchester
•Harcourt, Rev. W. V., F.R.S., F.G.S. York
•Hamilton, Rev. J., St. Mary's Abbey, Trim
Hall, Elias, Eton's Hotel, Eden-quay
•Hume, Doctor Thomas, 53, Dawson-street
Hall, William, 17, Upper Gloucester-street
Hall, John, ditto
•Harris, William Snow, F.R.S. Plymouth
Hardy, Philip D. M.R.I.A. 37, Stephen's-green
Homan, John, A.M. 19, Trinity College
Haire, James, 17, Summer-hill
Hall, J. T. Mountjoy-square
•Hawkins, John Isaac, Civil Engineer, Hamstead Row, London
Hare, Samuel, 47, Dawson-street
•Halswell, E., M.A., M.R.I. Brompton, London
Hely, Matthew, London
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Holt, Henry, Notton, near Wakefield
Holl, William, Birmingham
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Harris, Hon. Charles, Oxford
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Leitrim, Earl of, Killadron
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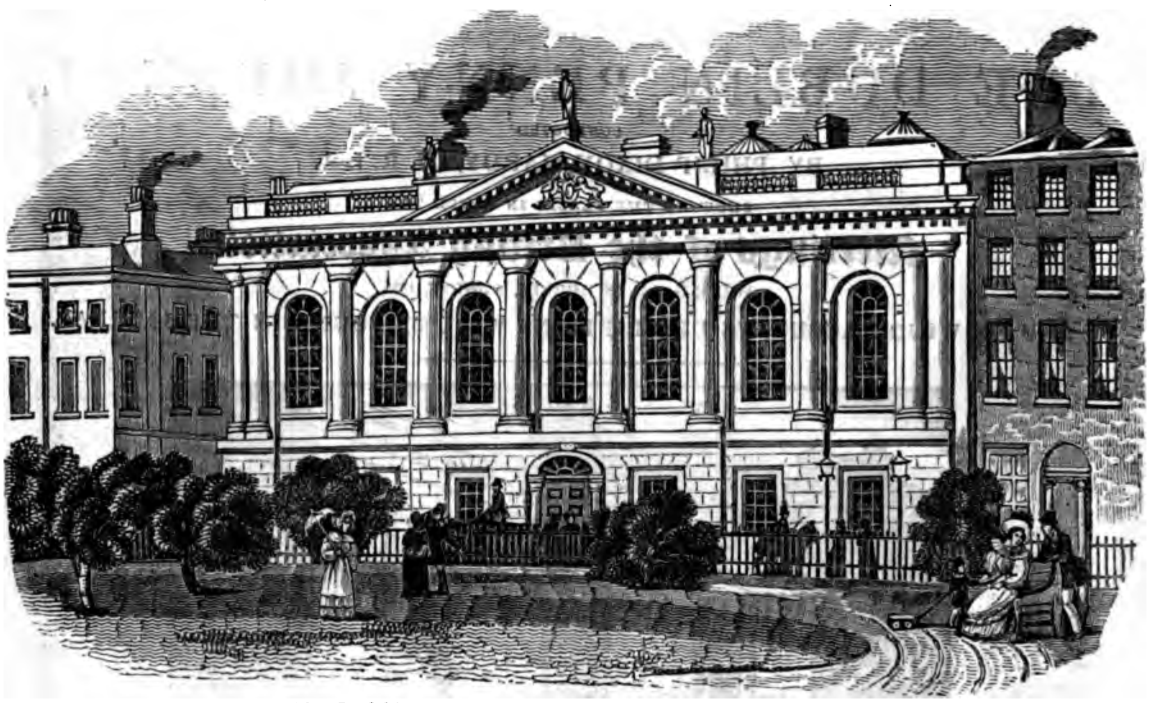

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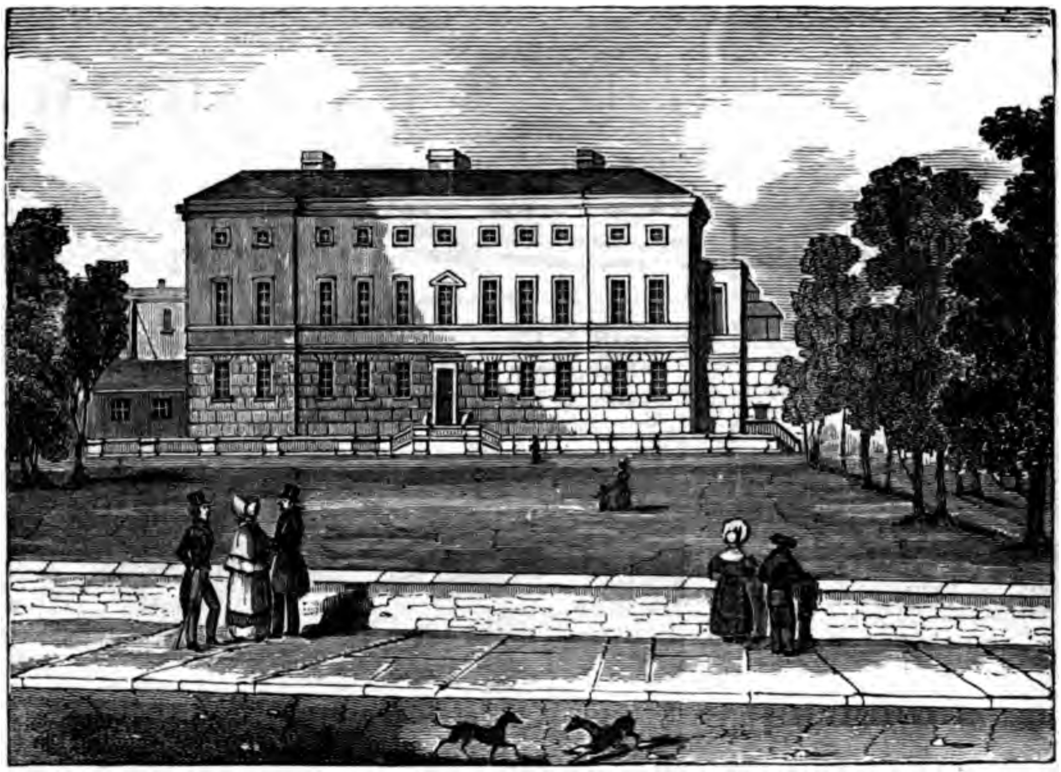

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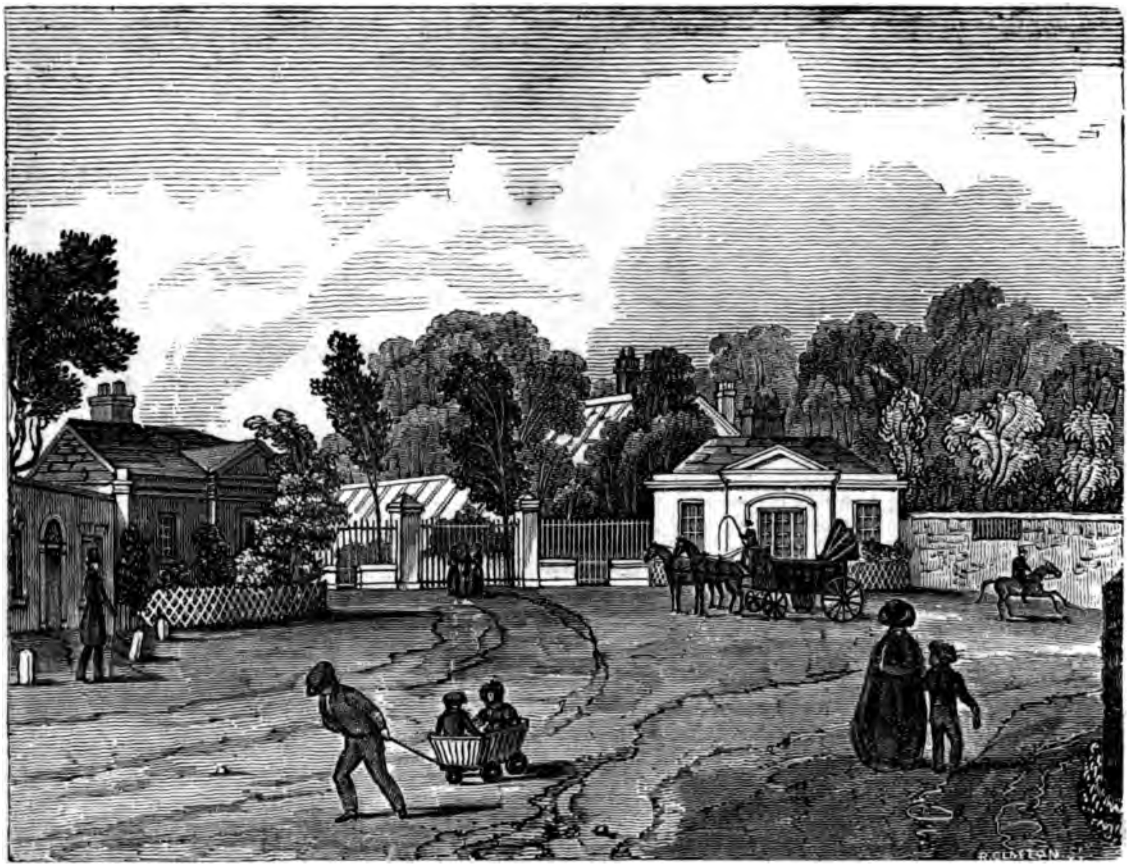

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